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For JULY, 1945

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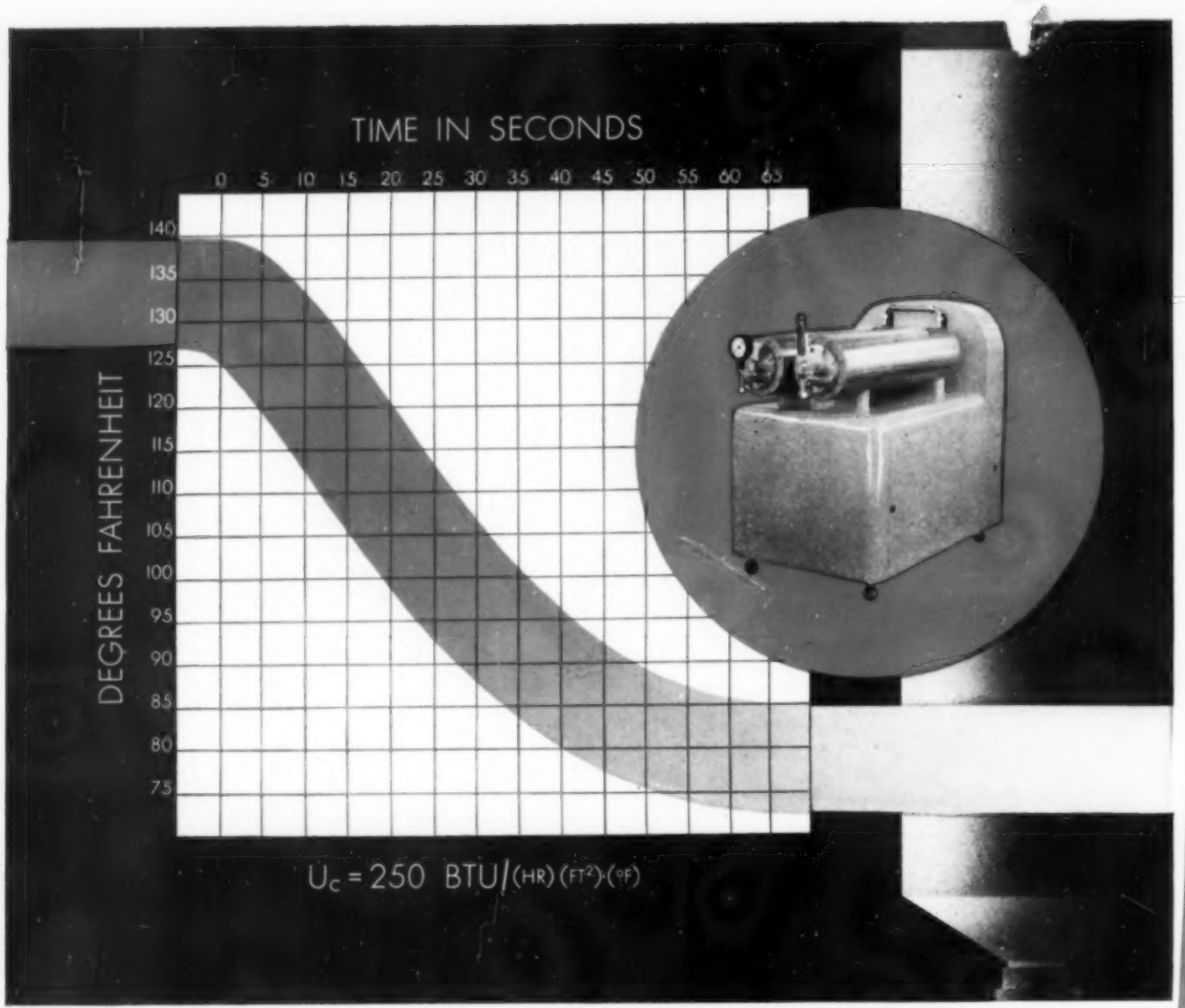

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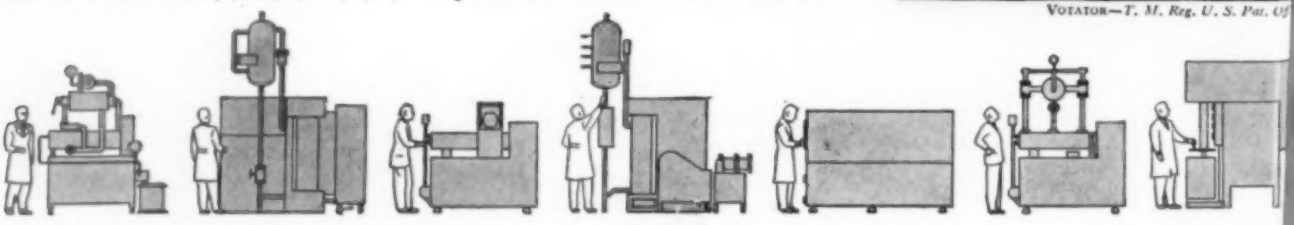

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CHEMICAL & METALLURGICAL ENGINEERING

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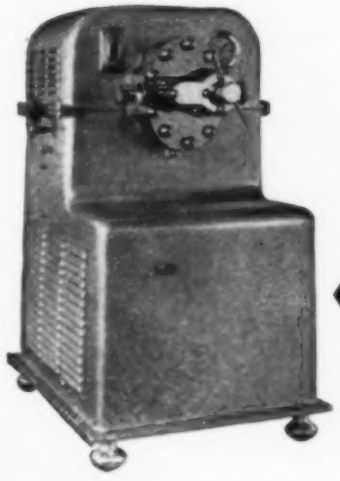

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WATCHING WASHINGTON

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Disposal of Government Rubber and Rubber-Chemical Plants Involves Problems of Patents, Monopoly, and Extent of Consuming Markets . . . Official Action to Increase Use of Natural Gas for Chemical Production is Urged by Manufacturing Chemists' Association . . . Way Has Been Cleared for Entry Into This Country of German and Austrian Technologists and for Their Employment in Industry . . . WAA Engineers Develop Plan for Converting Pacific Coast Magnesium Ingot Plant to Production of Calcium Cyanamide . . . Brownsville Plant for Producing High-Octane Gasoline From Natural Gas May Lead to Erection of Several Such Plants . . . Shortage of Steel Delays Modernization and Expansion of Chemical Plants

DISPOSING OF BIG RUBBER

HOPING to secure approval for its plan during this session of Congress, War Assets Administration has sent to Congress a program for the disposal of the bulk of the government-owned synthetic rubber plants, namely, the butadiene plants and the GR-S (general purpose rubber) copolymer installations. The program is, in fact, the body of recommendations which the Interagency Rubber Committee sent to OWMR a few days before WAA acted. Involved are 15 GR-S copolymer plants, 10 petroleum butadiene plants and 3 alcohol butadiene plants. WAA doubts that monopoly angles will hinder disposal.

Installations which because of high production costs or unfavorable locations are less desirable will be placed in the "fringe" category to be disposed of without conditions. The more attractive units will be designated "basic" to national security and sale or lease will be subject to the following reservations: (1) They must be operated for rubber production, subject to government controls, during the shortage of natural rubber, (2) they must not be altered, without government consent, even after termination of the present shortage if alterations would prevent their return to rubber production.

All the three alcohol butadiene plants are immediately offered for disposal, but the disposal of one will carry with it a provision that the plant must remain in condition to revert to butadiene production if necessary.

SPECIALTY RUBBER DISPOSAL

WAR Assets Administration also has rushed to Congress its program for disposal of specialty rubber and rubber chemical plants costing over $5 million, following the brief recommendation last February of the Interagency Rubber Committee that this group should be marketed forthwith. The batch, consisting of two butyl rubber plants, one neoprene plant, five styrene plants, one furfural plant and one carbon black plant, aggregates a $182 million government investment. With the exception of styrene, WAA sees complications ahead in disposing of the group.

There are patent and monopoly elements present. WAA admits that "Among the difficulties . . . one is the monopoly issue which may arise in the case of the butyl, neoprene and furfural plants." Standard Oil of New Jersey, Du Pont and Quaker Oats are dominant, respectively, in butyl, neoprene and furfural production. "One at least of the butyl plants," says WAA, "must remain so completely dependent for its raw materials on the adjacent refinery owned by the present operator of the butyl plant as to make it doubtful whether separate ownership of the two facilities would be feasible." This reference is to the butyl plant at Baton Rouge.

WHAT OF THE MARKETS?

ARE THERE sufficient markets for the products of the specialty rubber plants and related installations which WAA is trying to sell or lease? WAA has tried to answer this obviously important question in filing its disposal program with Congress.

Butyl rubber—Because of its special qualities, particularly with reference to inner tube manufacture, butyl is likely to enjoy in the near future a demand "greatly in excess of probable production . . ." At present all production capacity is government-owned. Manufacturing cost last year, excluding plant amortization, averaged 16c. per lb.

Neoprene—Demand for this product in 1946 should be 35,000 to 45,000 tons. About one-half the design capacity (60,000 tons per year) of the government plant at Louisville, will be required to meet this demand. "The privately owned capacity at Deepwater, N. J., which would compete with the output of the Louisville plant, is an important factor in case of disposal to a new operator." Average production cost in 1945, omitting plant amortization, interest and Washington office expense, was slightly over 22c. per lb., but costs have risen since.

Styrene—Dow Chemical's plant at Midland, Mich., has a capacity of about 36 million lb. per year. The government's five plants can make around 410 million annually.

CARBON BLACK, FURFURAL?

IN SUBMITTING its disposal program to Congress, War Assets is somewhat dubious about the prospects for getting rid of the government's $9.5 million carbon black plant at Odessa, Tex., not to mention five others under the $5 million level. WAA thinks the combined domestic and foreign demand for black may be 1.2 to 1.4 billion lb. per year for some time to come, which would approach the present combined private and government production capacity of 1.5 billion. However, WAA is bothered by the fact that it is usually more profitable to sell natural gas for other purposes than to carbon black plants, and wonders whether a bidder for the Odessa plant could manage to make a long-term contract for a gas supply.

WAA suspects that the future demand for furfural (capacity extended during the war to provide a solvent for butadiene extraction in refineries) will be substantially less than the total private and government capacity. The Quaker Oats plant at Cedar Rapids, Iowa, 12 million lb. per year, and the government plant at Memphis, Tenn., 24 million, have a total capacity of 36 million. WAA thinks that "within a few years annual consumption may rise as high as 24 million."

FINAL POLICY YET TO COME

THE Interagency Rubber Committee had not completed, at the time it issued its plans for disposal of rubber plants last month, its final recommendations for an ultimate national policy on rubber. However, the committee repeated its view expressed last

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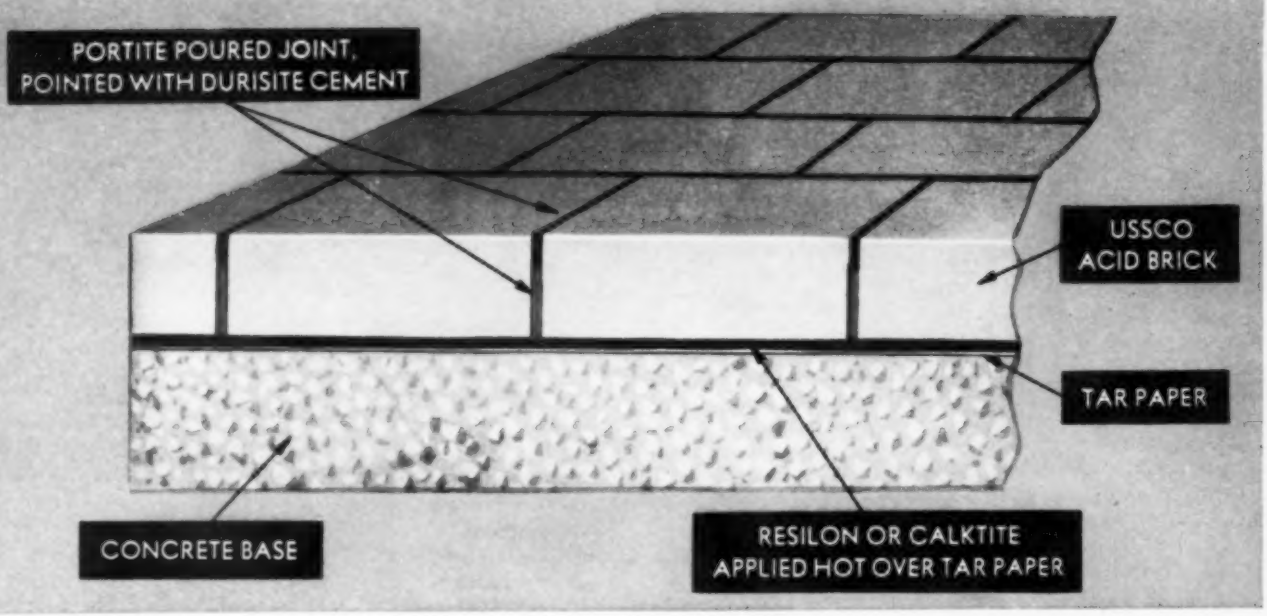
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February that the maintenance of the general-purpose synthetic rubber industry must be guaranteed by one means or another. Indications are that provisions will be made for the continuation, either in production or standby capacity, of about 600,000 long tons annually. Of this, around 150,000 tons will be in the form of one alcohol butadiene plant and an adjacent copolymer plant. Also, there will be maintained in Washington a national rubber agency, complete with industry advisers.

GAS FOR CHEMICAL INDUSTRY

Manufacturing Chemists' Association made a formal appearance before Federal Power Commission, urging that agency to take all possible official steps to encourage further natural gas supply for chemical manufacture. Warren N. Watson, secretary, presented a prepared statement at the FPC hearing which concluded with the following summary:

"The chemical industry is dependent upon natural gas as one of its most important sources of raw material, and the natural gas industry has in the chemical field one of its most important and rapidly expanding customers, and certainly one in which the natural gas consumed is utilized with high efficiency in maintaining the economic prosperity of the country. In the development of the natural gas reserves of the United States, the importance of natural gas to the chemical industry as a source of raw material should be fully recognized. It is sincerely hoped that those who engage in the future development of these reserves will give appropriate consideration to this very beneficial use, which enables a more complete utilization to be made of a resource which in years gone by has not been conserved too efficiently."

MORE THAN A FUEL

In his discussion of the advantages of natural gas for chemical processing, Mr. Watson presented the following striking comparison of the use of gas for chemical manufacture with its use as a fuel:

"The relative value of natural gas for use as chemical raw material as compared to its value as fuel is demonstrated. If 10,000,000 cu.ft. per day of natural gas is burned as fuel, its value is represented merely as the value of the heat produced, and would amount to approximately $730,000 per year, with gas evaluated at $0.20 per thousand cubic feet.

"On the other hand, if hydrocarbon concentrates from natural gas, in an amount having the same heating value as 10,000,000 cu.ft. per day of natural gas, were utilized as chemical raw material, the over-all economic benefits would be many times the value of the same material as fuel. To utilize this amount of hydrocarbon concentrate raw material in chemical manufacture would require a chemical plant having an investment approximating $25,000,000. Such a plant would employ directly about 1,500 men in the operation of the plant and the plant would produce in the order of 200,000,000 lb. per year of chemical products. In addition to the usage of natural gas, such a plant would utilize other raw materials as required for chemical manufacture and would normally use in the order of 200,000 tons per year of coal for steam production, and would consume approximately 9,000 kw. of electric power. It is apparent that natural gas and its components are of greater importance as raw materials than they are as a simple fuel."

HIRING GERMAN EXPERTS

The State, War and Navy Departments have, as a group, cleared the way for entry into the United States, without subsequent military surveillance, of German and Austrian scientists and technologists. The arrangements established have been concurred in by the Departments of Justice and Commerce. It is understood in Washington that the action has followed considerable demand from private industry and institutions for the services of these experts. Hitherto the transfers of such aliens to the United States, and their later activities, have been in the hands of the military.

Government departments and independent agencies have been advised of the conditions laid down in the new policy. In general terms the policy has been adopted to facilitate entry of a limited number of prominent foreign specialists for whom it can be shown that their entry is in the national interest and that they are without Nazi taint. Acceptance of the services of the specialists will be strictly on a voluntary basis as far as their wishes are concerned. Inventions and discoveries made here by the aliens will be made public as far as security considerations allow. It is expected that the specialists will be employed principally by non-profit institutions and government agencies.

TERMS OF ENTRY

Prospective employers of German and Austrian experts must obtain governmental approval and share to some extent with others the accomplishments of these experts in the United States. Normally, their employment will have to be maintained in cooperation with other interested enterprises, perhaps by establishment of university fellowships. Exceptions to the general policy may be granted, however. In every instance the terms of employment will require adherence to what the government regards as protection of public interest. It is specified that any patents resulting from the services of an alien shall be freely licensed on a non-exclusive basis on reasonable terms.

A prospective employer other than a government agency will be required (1) to engage the alien under contract or other fixed arrangement, (2) secure sponsorship by a government agency for such engagement. A sponsoring agency must certify to the Department of Commerce that entry of the alien would benefit the field of activity in which that agency has a responsibility and must exhibit the terms of employment proposed. Commerce will then relay its information and views to the State Department and to the Joint Chiefs of Staff for final clearance and arrangement of transportation.

FURTHER GERMAN OIL STUDY

A three-man committee appointed last December by the Technical Oil Mission organized by the Bureau of Mines and Petroleum Administration for War has strongly urged further investigation of German progress in synthetic liquid fuels. The committee bases its views on reports previously written by American investigators and on microfilms of German documents. The committee says that comprehensive process reports should be prepared by German authorities working in Germany under American supervision, and that special efforts should be made to secure views of German scientists and technologists as to attractive future lines of research and future applications of discoveries made during the war.

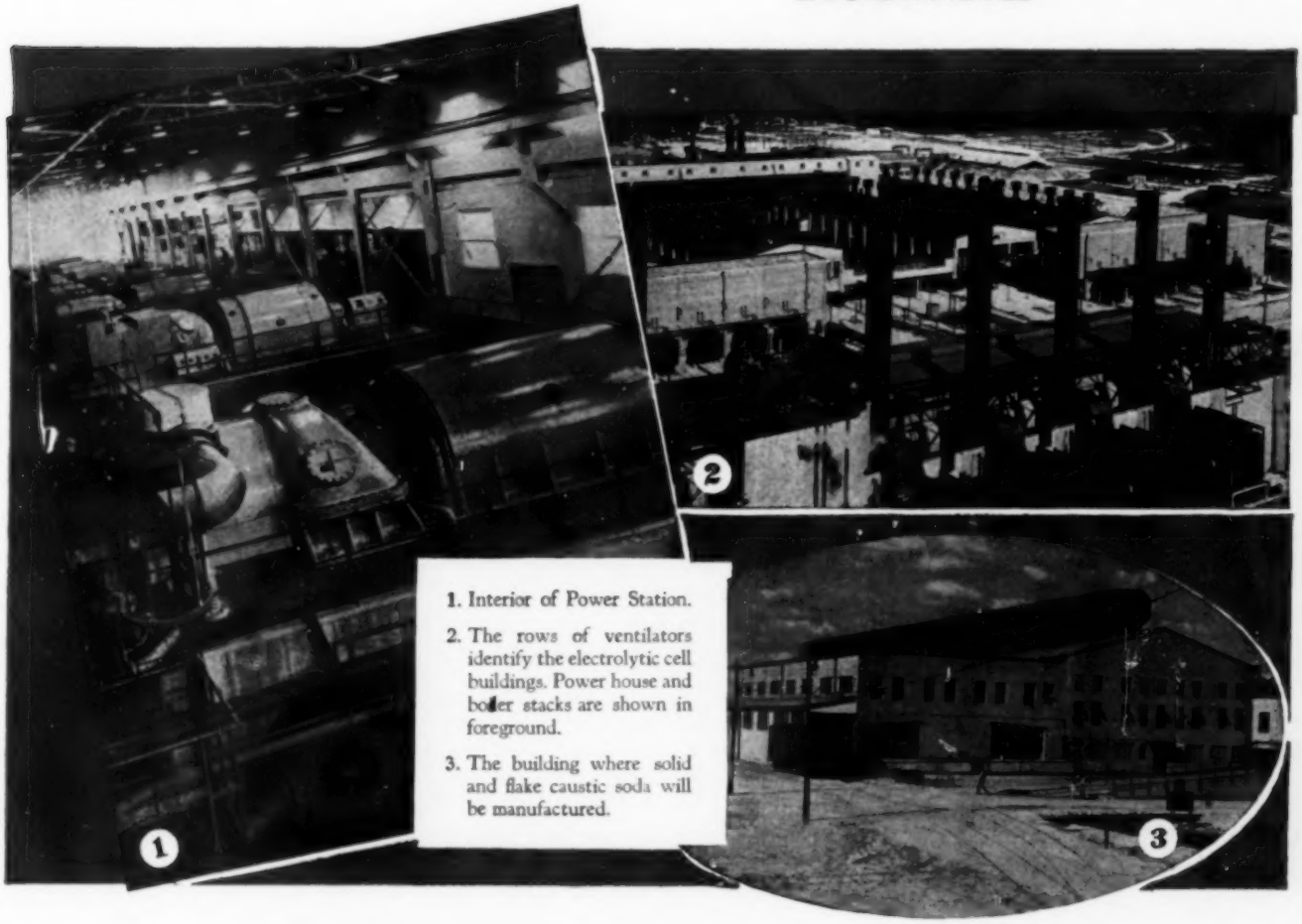
Other phases of the recommendations include approval of efforts of the Department of Commerce to bring new types of German equipment to this country for experimental work, and the importation of German experts who could assist in research activities of the American petroleum industries and the synthetic liquid fuels program of the Bureau of Mines. Committee members are H. V. Atwell, The Texas Co.; W. F. Faragher, Houdry Process Corp.; and I. H. Jones, the Koppers Co.

MAGNESIUM INTO CYANAMIDE

War Assets Administration engineers have developed a plan for converting one of the government's magnesium ingot plants to the production of calcium cyanamide. The plant is the (ferrosilicon process) installation at Spokane, Wash., leased during the war by the Electro Metallurgical Co. Several companies on the Pacific Coast are interested in the project as a source of local supply of cyanamide for that region. It is understood that WAA was expecting to receive at least two bids last month.

The conversion project centers about the alteration of the magnesium furnaces for the production of cyanamide. The required nitrogen equipment is not on hand but is available from other government surpluses. Current estimates place the cost of conversion at around $300,000. A feature of the conversion plan is that the present resistors

Lake Charles Plant will increase *Caustic Soda—Chlorine* Production



1. Interior of Power Station.
2. The rows of ventilators identify the electrolytic cell buildings. Power house and boiler stacks are shown in foreground.
3. The building where solid and flake caustic soda will be manufactured.

Built to make wartime magnesium, "Lake Charles" is being converted to the manufacture of chlorine and caustic soda. While actual production will not start until some time next year, the existence of certain vital facilities permits an earlier start than would be possible by constructing an entirely new plant. "Lake Charles" will be operated by The Southern Alkali Corporation—a Pittsburgh Plate Glass Company affiliate. Located in Louisiana, this plant adds an important link to a cross-the-country group of facilities, all strategically located to serve industry efficiently and economically. This group includes a Texas Plant at Corpus Christi—owned by The Southern Alkali Corporation—and Columbia plants at Barberton, Ohio, Natrium, W. Va., and Owens Lake, Calif.

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in the magnesium furnaces will be protected by suitable insulation in order that the plant could be returned to magnesium manufacture within 90 days notice. This provision was embodied in the program for disposal of certain magnesium plants which Surplus Property Administration filed with Congress last December.

FUEL PLANT AUTHORIZED

PRODUCTION of low-cost high-octane gasoline from natural gas is the objective of Carthage Hydrocol, Inc., a newly organized company which plans to spend from $15 to $18 million at Brownsville, Tex., on this new chemical engineering enterprise. RFC has agreed to loan $9 million for the project, to be used by the new company after the plant is about half completed.

The process to be used is that developed by P. C. Keith and associates through Hydrocarbon Research, Inc. This development firm has granted the new company royalty-free use of the Hydrocol patents. This first plant at Brownsville will have a rated capacity of 240,000 gal. daily of premium grade gasoline material and as byproducts about 1,200 bbl. of synthetic diesel oil and 70,000 lb. of industrial alcohol.

WASTE GAS PROJECTS

THE Brownsville plant of Carthage Hydrocol is the first of a considerable number of plants which the owners of the Hydrocol patents hope to establish as soon as final commercial engineering demonstration has been made at the first plant. Waste natural gas from the oil fields in the Rio Grande valley will serve this first establishment. Contracts have already been let for the needed natural gas for 17 years. Backers of the first plant include The Texas Co., United Gas Corp., Gulf States Oil, Stone and Webster, Niagara Share Corp., and The Chicago Corp. It is expected that as later plants are built the financial backing for each will include those having waste natural gas, those interested in securing the blending grade of gasoline material, and other interested groups of the petroleum, natural gas, and engineering industries.

END-USE DATA LAG

BY THE last week in June the Census Bureau has published end-use data on 13 chemicals which were under control by WPB during the war, and had prepared a much larger batch. Under arrangements with CPA such material requires official clearance from that agency. Inquiries recently made at CPA brought out the statement that there was lack of time for prompt handling of the Census tabulations.

Census has had end-use data ready on the following: anhydrous ammonia, acetic anhydride, isopropyl alcohol, phosphorus, carbon tetrachloride, acetic acid, dibutyl phthalate, diethyl phthalate, dimenthyl phthalate, phthalate plasticizers in addition to the three phthalates named, potash salts (as potassium oxide), ethyl alcohol, sulphuric acid, calcium carbide, phosphate plasticizers, ethyl acetate, ethyl ether, vinyl resins, alkyd resins, cellulose plastics, resins and molding compounds, styrene resins, coal-tar acid resin mixtures, chlorine, trisodium phosphate, disodium phosphate, hydroquinone, postassium chlorate, refined pyridine, anhydrous hydrofluoric acid, tetrasodium pyrophosphate, sodium metaphosphate, and butyl alcohols other than normal.

UNSPENDABLE MILLIONS

EVERY major chemical enterprise is complaining in Washington that it can not do needed modernization and expansion construction work. The problem is to get materials of construction, many of which are scarcer now than during the war period.

One unofficial estimate is that several hundred million dollars of chemical plant building will be delayed a year or more by this situation. One outstanding chemical engineer is quoted as saying that his company wants to spend more than three times as much as they are able to use under present circumstances. And he was referring, so it is stated, to projects which add up to nearly $100 million for the three-year period beginning with 1946.

LITTLE RELIEF EXPECTED

CLOSE observers in Washington expect no relief from the difficulty in getting construction materials until at least election day. In the meantime every official action is governed by the desire to make a showing for veterans' aid, to encourage men now out of uniform "to vote right."

After election there may be, as one Washington association executive put it, "some return to reality." But it is not expected that there will be any general abandonment of veterans' housing priorities even by the end of this calendar year. The most that can be expected is that some consideration will be given by the year end to the urgent necessity of renewed industrial construction which is just as important to veterans as it is to industrial executives.

STEEL IS BOTTLENECK

FOR the majority of process industry the scarcity of steel and steel products seems to be more serious than any other factor. This scarcity limits construction, because of diversion to veterans' programs. But equipment manufacture is equally seriously hit and Civilian Production Administration can do little more for machinery purchasers than it can for those who want structural steel. Container scarcity is almost equally as critical a problem for many industries.

DEMURRAGE AGAIN

OFFICE of Defense Transportation found necessary in June the fixing again of high demurrage rates on box cars by ICC Service Order 369B which renews the requirement of very high demurrage after the first 24 hours of free time on all box cars. Rates range from $5.50 for the first day up to $22 per day after the third day. Thus industry must in effect empty cars immediately or incur very large extra costs.

The principal cause of box car shortage during the summer is the necessity for grain movement for famine relief. High priority is given to such wheat and other cereal movement to export ports. When the present movement is over, there may be some relaxation of box car troubles. But Washington does not expect adequate freight-car supply for a long time to come. Relief which might otherwise be available is prevented by the inability of railroads either to build or to repair cars adequately. That difficulty comes from giving priority to veterans' housing for almost all clases of construction materials.

CONTROLS STILL NEEDED

ODT ANNOUNCED some time ago that it expected to rescind most of its restrictive orders this summer. However, it now finds that scarcity of equipment makes necessary most of the major controls which were established first for war purposes. Already renewed or extended are the requirements of General Order ODT 18A which requires maximum loading of all freight cars. Also continued are ODT 1 which requires a minimum of 10 tons loading for l.c.l. freight and ODT 16C which regulates freight to ports.

CHLORINE REPORT AVAILABLE

EARLY in July distribution began of copies of the first big report on the chlorine mercury cell as used in Germany. Reproduction of the report was arranged by Chemical Alliance and sets of this first report are being sold at $10 per copy. Industrial executives and chemical engineers are invited to arrange for purchases (with a remittance of this sum) through Warren N. Watson, secretary, Manufacturing Chemists' Association, Woodward Building, Washington 5, D. C.

This first report was made by the team of industry investigators sent over by Chemical Warfare Service some months ago. The first part includes cost data, flow sheets, and blue prints of the extensive drawings of equipment. MCA executives decided that reproduction should be undertaken at cost through Chemical Alliance which is the all-industry agency of chemical manufacturers. By such action, reasonably prompt reproduction was made possible and every unit of industry can get a copy at actual cost.

Dowtherm on the job!

Taming high temperatures for the plastics industry

Accurate temperature control is a "must" for many of the plastics industry's delicate processing operations. That's one reason why Dowtherm's precision heating . . . easily regulated, always uniform . . . is looked upon as an important asset by so many plastics manufacturers.

In the production of nylon yarn, for example, careful temperature control is of utmost importance during several stages of the operation. Here Dowtherm is employed as the heat-transfer medium. With Dowtherm vapor heating, temperatures may be regulated at the turn of a valve . . . held constant at the correct point throughout the entire heating surface. And increased safety and simplicity of operation are made possible by Dowtherm's combination of high temperature with low operating pressure.

If you are looking for precise, low-pressure heating within the 300°-750° F. range, a Dowtherm system may be your answer! Dowtherm has brought simplicity of operation, reduced upkeep costs, and greater uniformity of product to hundreds of high-temperature processors in many industries. A line to Dow will bring you complete information.

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Dowtherm

The high-temperature low-pressure heat transfer medium

DOW

CHEMICALS INDISPENSABLE TO INDUSTRY AND AGRICULTURE

The arrangement was made through the joint request of Chemical Warfare Service and Office of the Publication Board.

FINAL REPORT LATER

THE complete report of the chlorine industry committee is being written in Europe during July. It is hoped that the complete document may be delivered to Chemical Warfare Service before August 1. It will then be promptly reviewed and presumably released minus only such details as seem to have only military significance. It is anticipated, and hoped, that Chemical Alliance will later undertake reproduction of the final text of the report with the conclusions of the committee in the same manner as it has arranged for the first report.

JUNIOR SCIENTISTS WANTED

UNCLE SAM is going to need a substantial number of junior scientific and engineering employees. To provide for these beginners in the professional service of the government there have been announced assembled written examinations for chemist, physicist and engineer. Initial salary of this professional grade is $2,644.80 per year from the effective date of the new salary schedule recently approved by Congress.

First date for written examination required application not later than July 10; but it is expected that at suitable intervals the government will hold similar examinations. Individuals interested in making an application can request Civil Service Commission, Washington 25, D. C. to put their names on the mailing list to be sent notice of examination when further announcement is made.

Other scientific and engineering appointments of higher grades will be made on the basis of applications, or so-called "unassembled" examination. Only those who have merely completed college work in an accredited curriculum, with little other experience, are expected to take the junior positions. The next higher rating requires a few years' experience, the amount varying with the type of work and the character of the experience.

Washington observers point out that this new government policy of granting a beginning salary of more than $2,600 per year is likely to set the pattern for industrial positions of like nature.

APC CUTBACK MADE

ALIEN Property Custodian work in marketing vested patents has been cut back substantially due to restriction of funds appropriated for that agency. Field offices of the Division of Patent Administration are being closed and files of patents in them transferred for public access elsewhere. The files in Chicago and Boston have been transferred to the municipal public libraries, but the Los Angeles files will be continued in the APC offices of that city which are continued for other than patent work. Practically all further discussion of vested patents will now be limited to dealings with the main offices in Washington.

ORI CONTRACTS

OFFICE of Research and Inventions of the Navy Department has under negotiation or recently executed a large number of research contracts. The purpose is to have educational institutions and independent research laboratories work on fundamental questions of importance to the Navy in its long-term programs. The initial group of approximately 75 contracts which had been signed before the first of June were largely those which have been negotiated with educational institutions. A much larger number are still at the "tentative agreement" or earlier "discussion" stages. It is expected that very many of these will become effective early this fiscal year, which began July 1. A slightly larger number of industrial laboratories is expected to participate in this new group of activities.

ANTI-FREEZE HIT AGAIN

ANTI-FREEZE makers are having a terrible time packaging their production. All containers have been scarce for some months, but during June and July there have been no light gage steel drums available. This shortage has been more serious because it has occurred at precisely the season when the bulk of the production is being packaged for fall deliveries.

CORN SIRUP EXPORT

APPROXIMATELY 110,000 light gage steel drums of 55-gal. capacity were allocated in June and July for corn sirup export. Corn to make this sirup was especially provided because the sirup is for famine relief abroad. This special production has not interfered with domestic output of corn products which might otherwise have been made because domestic supplies of starch and sirup already were seriously restricted by limitation on corn supplies for wet grinding. There was ample plant capacity to care for this special famine relief job, because all plants had been running far below rated output.

WAR PERMITS TO LAPSE

MANY pressure containers for chemicals, liquefied petroleum products, and industrial gases have been used during the war period under special permits. These non-specification containers are going to be withdrawn from transportation by cancellation of special permits which allowed their use as a war measure.

First of the war permits to terminate probably will be the one which permitted non-specification tank cars to be used for liquefied petroleum gases. ICC has indicated that this use will not be permitted after Jan. 1, 1947. The terminal date for most other permits has not yet been announced.

Manufacturing Chemists' Association has warned its members that every company should review its container problem critically at an early date. Non-specification containers can not be quickly replaced in most cases both because of shortage of steel and shortage of fabricating capacity. Interested companies or groups are therefore urged to prepare their requests for further continuance of special permits so that they may go to ICC promptly and prevent interruption of transport service.

UNDERGROUND SITES STUDIED

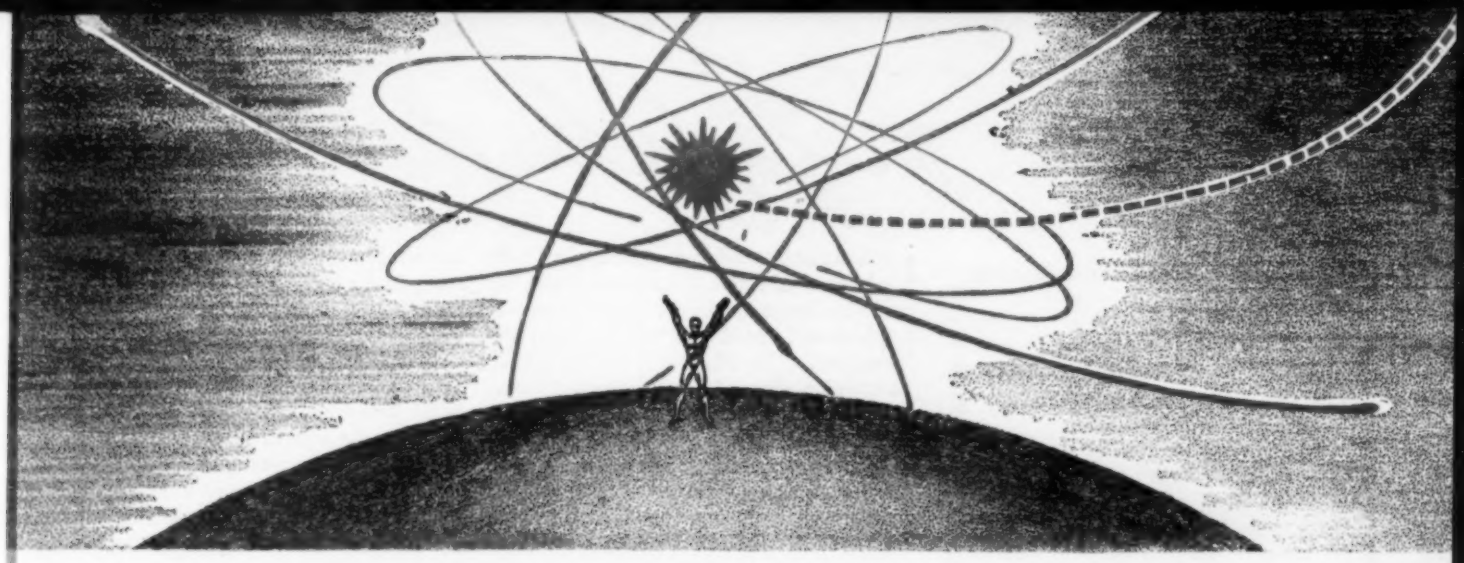
WAR Department officials in Washington minimize any idea that the current surveys being made by the Underground Sites Committee of the Army-Navy Munitions Board mean that the government is particularly concerned about the need for putting strategic industries in caverns in the event of war. These officials insist that the primary objective of the work is to find storage space for government-owned machine tools and strategic materials.

FPC APPROVES BIG GAS LINE

NATURAL gas pipeline of 30-in. diameter, largest ever approved by the Federal Power Commission, is part of a $70 million project which FPC has authorized in order to bring 305 million ft. per day of natural gas from West Texas and New Mexico to the Los Angeles area. The 30-in. line will stretch 214 miles from Santa Fe Springs, Calif., to the Arizona-California border. Other major sections include 737 miles of 26-in. line from the border to Lea County, Tex., and a 251-mile extension of 24-in. line from Dumas, Tex., to Lea County.

Authority to construct and operate the system was granted to El Paso Natural Gas Co., Southern California Gas Co. and Southern Counties Gas Co. Deliveries to the two California companies are expected to begin by next June. Rates will begin at 15c. per 1,000 ft. and be fixed at 14c. after the fourth year. FPC belives that about 75 percent of the gas will be that which at present is wasted in the fields.

Maximum daily contracted volumes are 125 million ft. in the first year, 175 million during the second, third and fourth, and 305 million thereafter. It is estimated that to produce in recovered heat the amount of total heat contained in the 305 million, 500 cars of coal to be burned at 65 percent efficiency would have to be shipped to California each day.



MAN vs ATOM—YEAR 1

WHEREIN WE SIGNALIZE THE FIRST ANNIVERSARY OF THE ATOMIC AGE, CONSIDER THE ALTERNATIVES INHERENT IN BOTH GOOD AND EVIL POTENTIALITIES OF NUCLEAR FISSION, THEN VENTURE A GLIMPSE INTO THE FUTURE

A YEAR AGO, July 16, 1945, at Alamogordo, New Mexico, man created the first atomic explosion. Most impressive events diminish in stature as they recede in time. This one grows bigger with each passing day. It truly marked the beginning of a new age.

As Year 1 of the Atomic Age ends and Year 2 begins, we are engaged in three portentous projects.

At Bikini Atoll we are detonating the fourth and, possibly, the fifth atomic explosions in the history of the world.

At Oak Ridge, Tennessee, we are building the first atomic energy plant for peaceful purposes.

Most important, in New York we and all the other United Nations are engaged in the first attempt to subject atomic energy to international control. Literally, the fate of the world hangs on this attempt.

As this introduction is written, the United Nations Atomic Energy Commission has just begun its work. People everywhere pray for its success—for their own sake, but even more for their children and for their grandchildren. If this Commission fails let everyone everywhere be warned: the world has taken a step toward destruction.

As we enter the second year of the Atomic Age, the nations of the earth are embarked on an atomic armaments race. There is no blinking that fact. We have had official notice served on us. Therefore, we must understand that unless the United Nations Commission can arrest the drift of events, we are moving toward a horrible war. The Commission must succeed.

The American delegate, Mr. Baruch, has brought to the Commission an ably thought out plan. It would internationalize nuclear science, and release for mankind the beneficent applications of atomic energy. But it would "control" atomic bombs only to the extent of giving the world brief warning of any nation's preparation to use them, so that we might have foreknowledge of disaster.

Therefore, the real and enormous task before the world becomes clear. We must end war. No other control of atomic weapons exists. If war comes, atomic weapons will be used. If they are used, our children who survive will curse their fathers. Understanding the consequences of failure, we *must* succeed.

Because we cannot succeed without knowledge, I have asked my associates at McGraw-Hill to condense into the following pages what we know at the close of Year 1 about this great new atomic force—its basic science, its possible uses and its political repercussions.

James H. McGraw, Jr.

President, McGraw-Hill Publishing Co., Inc.

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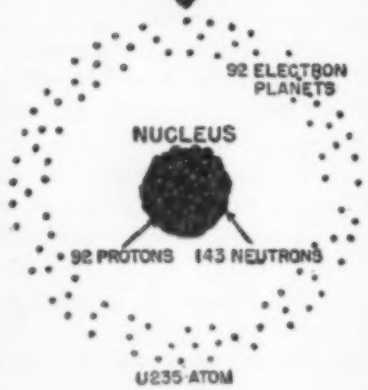
This Fateful Atom...

1 ORE TO U235

Only 0.7% of natural uranium is U235

URANIUM ORE



2 CHAIN REACTION

Fragments from earlier nuclear explosions smash other nuclei

LOOKING BACK twelve months to the birth of Year 1, Atomic Age, we begin to sense the majestic import of the atomic bomb that blasted the naked desert at Alamogordo, N. M., on July 16, 1945. There man first shattered atoms in an explosive *fast-chain* reaction. Then came Hiroshima and Nagasaki.

In every case the fateful atom was either uranium 235 (U235), or plutonium derived from the action of U235 on U238. Every pound of U235 atoms split in these unprecedented blasts yielded the energy of 11.4 million kilowatt-hours, or 1400 tons of coal — slightly more for plutonium.

No matter where one mines uranium ore, the purified natural uranium (Fig. 1) always contains 99.3% of the "garden" variety U238, and a mere 0.7% of the precious U235.

An atom is like our solar system. The central sun is the nucleus — a bunched mass of protons and neutrons, each weighing one unit. The planets are electrons. Each proton has one plus electrical charge — each electron an equal negative charge. There must be as many negative electron planets as positive protons in the nucleus. This is also the "number" of the atom. Neutrons have no charge, but add weight.

The atomic number of uranium is 92 because the uranium atom always has 92 nuclear protons and 92 electron planets. The isotopes U238 and U235 differ only in the number of neutrons; U238 has 146 neutrons, and weighs 92 + 146 = 238 units. U235 has 143 neutrons, and weighs 92 + 143 = 235 units.

Ordinary chemical reactions, such as TNT explosions, release only a fraction of the modest energy of the whirling electrons in the outer atom. Nuclear reactions unlock the immensely greater energies which bind together the nucleus.

Even the gentle tap of a slow-moving neutron bullet will split the atom of U235 or of man-made plutonium into two medium-weight atoms, yielding also one to three spare neutrons plus energy. Thus these *fissionable* materials supply both their own bullets and a highly sensitive lot of high-explosive targets — a perfect setup for a *chain reaction* (Fig. 2).

Chain reactions work like chain letters. Neutrons from one nuclear explosion hit and explode other nuclei. But, since atoms are mostly open spaces a chain started in a small block of U235 or plutonium quickly dies out because most of the released neutrons escape from the block.

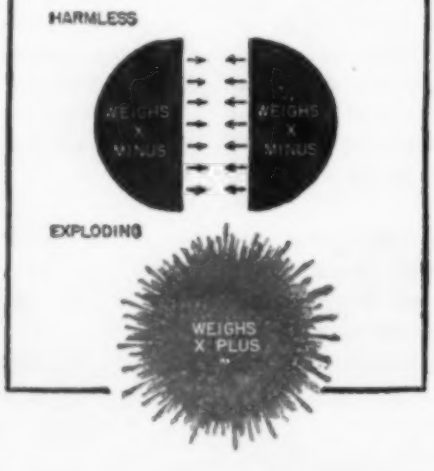
The bigger the block, the smaller will be the percentage of escaping neutrons, and the more left to split other nuclei. When the block is rapidly built up beyond a certain secret size the fragments of 1000 nuclear fissions split many more than 1000 additional nuclei. Then fissions multiply geometrically, and the block disintegrates with explosive speed and violence — as in a bomb (Fig. 3).

This bomb explosion is a fast-neutron chain. For economy and ease of control, uranium piles for the gradual release of nuclear energy for commercial purposes will normally use a lean fuel — that is U235 or plutonium diluted with U238, thorium or other less costly materials.

To maintain a chain reaction such piles must be large and artificially stimulated by using carbon blocks or some other *moderator* (Fig. 4) to slow many of the neutrons. Slow neutrons make more hits than fast neutrons because there is more time for them to be swerved from a straight path by the attraction of nearby nuclei, as shown below.

3 WHY BOMB EXPLODES

When block of rapidly assembled U235 passes secret critical size it explodes spontaneously



4 SLOW NEUTRONS MAKE MORE HITS

A slow neutron is more easily swerved from a straight line

can Serve Man . . .

THE FATEFUL U235 ATOM can serve man as a new, compact source of heat energy for power generation, comfort heating or industrial processing. Peacetime applications of atomic energy will use dilute U235 or plutonium as a "fuel," mixed with carbon or some other moderator to slow some of the neutrons and thus keep the chain reaction going.

The diluting agent may be either U238 or thorium, or both. These will do double duty, because neutron bullets convert U238 into the energy-yielding plutonium, and thorium into U233, which may prove equally serviceable.

Thus the commercial piles of the future will "burn" U235 to make other atomic fuels, plutonium and possibly U233, which in turn will deliver heat energy to the pile. In that way it will be possible to get from the pile far more heat than the equivalent of 1400 tons of coal for each pound of U235 split. This highly attractive prospect will speed the day when nuclear energy can compete with coal.

While already mechanically obsolete, the piles making plutonium for bombs at Hanford, Wash. (Fig. 1) reveal the basic principle on which future piles for power and heat will operate. The heat now wasted in vast quantities will be put to work. The plutonium, now removed for bomb manufacture, will be returned to the pile (or left in) as supplementary fuel.

ATOMIC POWER

The possible everyday applications of nuclear heat pictured in Fig. 2 have been recognized from the very first day of the Atomic Age. Year 2 will see the building of the world's first atomic power plant (a pilot plant) at Oak Ridge, Tenn.

Beyond question such installations will produce power, but it may be years or decades before they prove economical. To compete with conventional plants the piles must first be redesigned to run at temperatures high enough for good power-plant efficiency. Also the techniques of operating piles by remote control through the heavy radiation screens must be radically streamlined.

The Hanford piles run on natural uranium containing only 0.7% of U235. The typical commercial atomic power plant of the future will use more than 0.7% of U235 or plutonium, but less than 50%. This will avoid both the low efficiency of the too-lean mixture and the excessive fuel cost of the rich mixture. It will permit piles of moderate size and take maximum advantage of U238 and thorium as potential sources of plutonium and U233.

One should not expect U235 to replace coal generally in this generation, although a few central power stations and ships will try it out before Year 10 of the Atomic Age. Plants far from traditional sources of fuels may turn much sooner to uranium and thorium as concentrated heat sources, that may easily be transported even to remote corners of the earth.

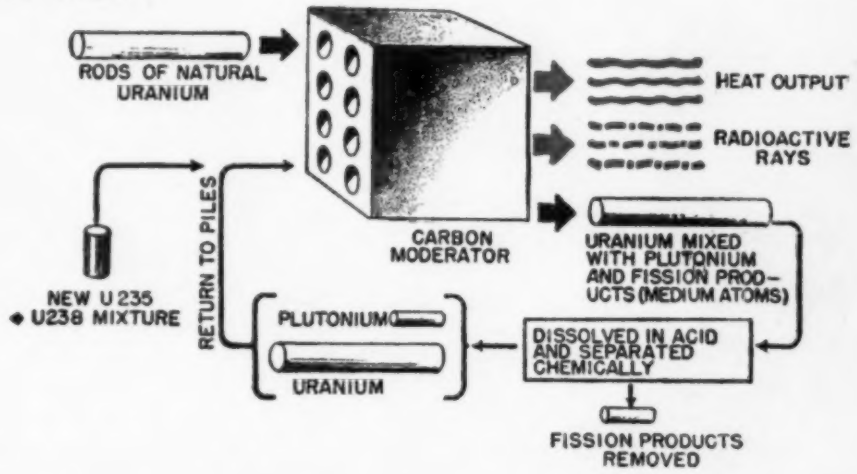
Atomic power, in forms now known, is impracticable for automobiles and small airplanes, because of the large initial investment in uranium and the need to carry 50 tons of shielding to protect riders and pedestrians against the deadly radioactivity accompanying nuclear fission.

RADIOACTIVE ISOTOPES

More immediately important than the heat and power applications of nuclear energy are the services that the radioactive byproducts of pile operation can render. Because these materials act chemically like their ordinary non-radioactive cousins, but can be followed and detected easily, they are expected to play tremendously vital parts in medicine and biology. For more details, see the last page of this section.

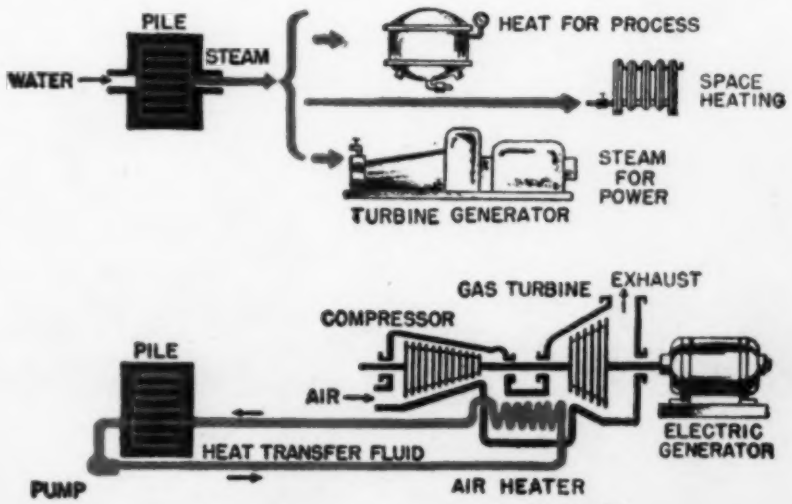
1 SLOW-NEUTRON PILE

Can make plutonium for bombs—or heat for power, process and comfort

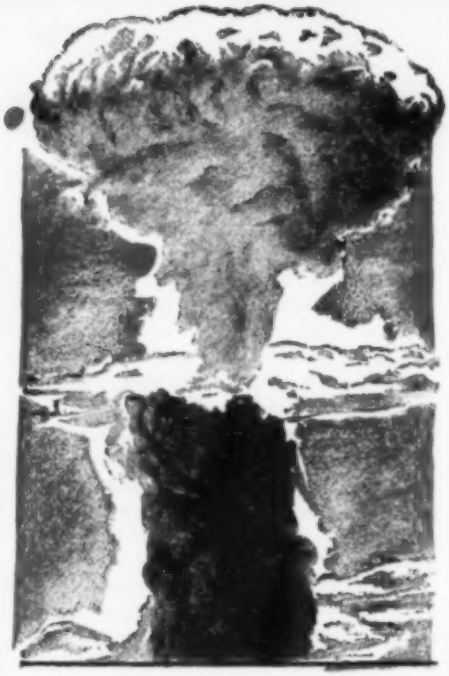


2 PRACTICAL APPLICATIONS

Include steam for turbines, process and comfort heating—also heat for gas turbines



or Destroy him . . .



A single improved atomic bomb can devastate ten square miles of city

URANIUM 235 and plutonium are now man's slaves. They will build or destroy as he orders. Man dreads this vast force only because he distrusts himself. War is proof that man in the mass has never achieved self-control. He has always sought better weapons; yet the perfect weapon now brings him no satisfaction for he sees in the atom bomb his own destruction as well as that of his enemy.

The ultimate benefits of nuclear energy may well surpass its present terrors, but the terrors are here now in awful dimension, and man must face them. He must pay this price for unlocking the wealth of the inner atom.

ATOMIC BOMB

This page, then, is about the atomic bomb. Nothing will be said here that is not either a certified scientific fact or a conclusion shared by the majority of the leading scientists, engineers and statesmen who have studied the matter.

As already explained, an explosive nuclear chain reaction spontaneously sweeps through a block of U235 or plutonium when the block is rapidly enlarged beyond a certain "critical" weight X. That weight is still a military secret; the official Smyth report vaguely suggests that it is more than 4 lb and less than 200 lb. Each piece of U235 in the dormant bomb must weigh less than X. At the desired instant of explosion the bomb mechanism assembles these pieces rapidly into a single piece considerably heavier than X.

The explosion itself drives the U235 pieces apart, thereby quenching the atomic conflagration before all the atoms are split, so the bomb efficiency is far less than 100%. For each pound of U235 (or plutonium) atoms actually split, the bomb releases the energy of 1400 tons of coal.

This explosion is mainly ordinary heat at work in unprecedented concentration. Bomb metals become incandescent vapor millions of degrees hot. This, and the enveloping sphere of glowing air, radiate a blinding flash that chars human flesh at half a mile and blisters at over a mile. There is a destructive shock wave (sound) and a second-long hurricane of unimaginable force — the outrushing of the expanding heated air. Deadly neutrons and gamma rays speed out from the bomb.

A single atomic bomb killed about 100,000 at Hiroshima. Fewer died at Nagasaki only because the circle of potential destruction included much vacant land. Bombs ten times more powerful can be made by the thousands in any major industrial country with the plants and the know-how. One bomb could saturate Minneapolis or downtown Manhattan.

Many experts estimate that a complete set of American atomic "secrets" and blueprints might save a foreign power two to three years at best in its race for atomic arms. With no help at all from us, any advanced industrial nation can, in five to ten years, acquire the raw materials, the plants, the know-how and enough bombs to knock out the big cities of any other country overnight. In Year 2 of the Atomic Age this arms race is already on.

It will not fail for lack of raw materials; every country has lean ores worth working for bombs.

There is no known defense against the atomic rocket attacking at mile-per-second speed

THE CHEAPEST DEATH

Cost need not deter, for the atomic bomb is by far the cheapest method of destruction ever devised. General H. H. Arnold estimates that atomic bombs can be manufactured *and delivered* for less than $500,000 per square mile of destruction.

Don't be misled by the two billion dollars America spent on a project that dropped only two bombs on the enemy. New plants can be built at a fraction of wartime cost, and the investment spread over thousands of bombs, not just two.

NO DEFENSE

So the bombs can be made in ample quantity and paid for, but can they be delivered? The answer is: "Yes; by the time the bombs are ready they can be delivered anywhere and overnight." If the defenses of the target country are weak, piloted planes can get through in ample number. Ten percent would be enough.

For more effective delivery radio-steered pilotless planes and rockets can carry the atom bombs faster than sound. Such weapons will be almost untouchable by either antiaircraft artillery or manflown fighters.

Greatest threat of all will be the transoceanic rockets. The German V-2 rocket, which never once was stopped by Britain's defenders, points one way. It needs only transatlantic range (with atomic propulsion) and an atomic bomb in the nose. Forty-six feet long, loaded with 7500 lb of alcohol fuel and 11,000 lb of liquid oxygen, the V-2 of World War II rose 60 miles in the air and arced 200 miles in five minutes to deposit one ton of TNT in London.

Seeing so many strange things come to pass, the man in the street cannot distinguish between possible miracles and the impossible variety. From the very start of the Atomic Age he has been hoping for a "ray" that will explode the atom bomb far off. Competent scientists and engineers say that cannot be.

The only way to bring down a 3500-mile-per-hour rocket at a safe distance is to chase it with your own 4000-mph rocket. You can't win at this game often enough to establish ironclad protection.

The only specific defense against the atomic rocket known in Year 2 of the Atomic Age is to disperse all cities and put key industries underground. This would be very costly in time, money and national morale.

MORE AND BETTER BOMBS?

Some will ask whether the U.S., as the most powerful industrial nation, could not build more and better bombs and carriers than any other nation. Probably yes, but there is still no real security. If the "weak" opponent has enough atomic weapons to destroy us once, what advantage is there in being able to destroy him twice?

Shooting first could protect us now, but not after the world is atomically armed. If we were to destroy the enemy's cities, we would probably miss his well-concealed and protected bomb magazines and rocket launchers. A few minutes later he could return the atomic fire. In brutal simplicity, that is the picture of future atomic war. Everybody loses.

At this point one grasps at another straw: "If everybody is to lose who would be so foolish as to start an atomic war? And didn't the Germans refrain from using gas for a similar reason?" Possibly yes. It *may* work that way. But in a world atomically armed to the teeth some nervous finger *may* pull the fatal trigger.

ONLY ONE WAY OUT

Throughout history each new offensive weapon has called out its appropriate defense. But now the offense leaps centuries ahead in a single bound and the defense lies almost helpless everywhere, unless some technical protection, unknown as Year 2 begins, can be devised.

The situation is extremely dangerous. There is no clear way out except through some sort of international action first to stop the atomic arms race and, before it is too late, to hobble war itself.

Can it be done? Perhaps not, but there is no alternative except atomic chaos.

...so he faces the Atomic Dilemma.

THE NUMBERED statements that follow in somewhat logical pattern are too fateful to be accepted on anybody's say-so. Every reader should test them in the light of his own information and understanding.

The points below sum up the conclusions of the previous article — and these in turn reflect a great mass of thought and discussion among leading scientists, engineers and statesmen close to the problem. To an amazing degree they concur on both facts and conclusions. For authoritative statements of their line of thought, in detail not possible here, the reader should see the recent book, *One World or None.*

THE DILEMMA

Nations must either face the probability of an atomic World War III, which would surely be the most deadly in history . . .

***Or,* the experts propose, yield both atomic weapons and war potential to international authority backed by superior force.**

What the Experts Say

1. In five to ten years any major industrial nation can make enough atom bombs to destroy all the major cities of any other country overnight.

2. This assumes no "secret" information or other help from us.

3. The necessary uranium ores will be at hand.

4. The cost will not be too high.

5. The bombs produced can then be carried thousands of miles by bombers, or by atomically powered guided missiles moving faster than sound.

6. There will probably be no effective military defense against such weapons.

7. Dispersing cities, and putting key industries deep underground, will give some protection if accomplished in time, but at incredible cost in money and human discomfort.

8. In a world atomically armed, nations can probably protect their bomb stocks and rocket launchers from enemy assault.

9. If so, nation A can destroy the cities of any other nation B, after which B's rockets will destroy the cities of A. Shooting first will not win an atomic war.

10. This knowledge may not restrain the trigger finger of a suspicious power.

11. Having more and better atomic weapons than the other fellow won't help much if he has enough to destroy us. No use to kill a man twice or rebomb urban ruins.

12. Every nation is vulnerable in the Atomic Age, including the U. S. A.

13. National security will be impossible without (first) international control of atomic arms and (not too long thereafter) international control of all war potential, both backed by superior physical power.

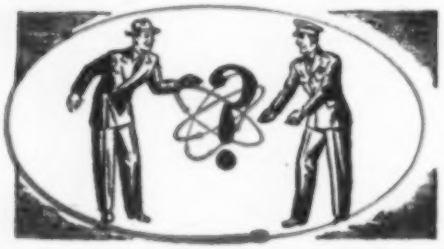
14. If action to this end is long delayed, it may become impossible to halt the atomic arms race already started.

15. At best, the necessary degree of international control, with some real delegation of national sovereignty, will be a revolution in human affairs. It may prove to be humanly unobtainable at this time. If so, men and women everywhere must face the probability of an atomic third world war—by far the most destructive in all history.

In this atomic age no nation can be safe through its own unaided might

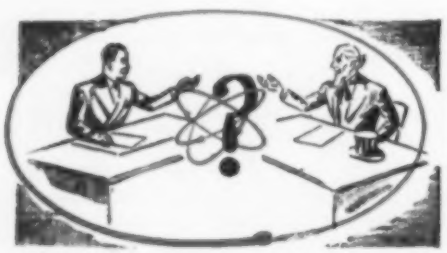
...and the Great Debate unfolds

ATOM YEAR 1 has probably been marked by more debate on a single subject than any other twelve months in the world's history. Social, economic and political as well as purely technical issues have been pressing for realistic solution. Let us look at these issues and see where we stand:



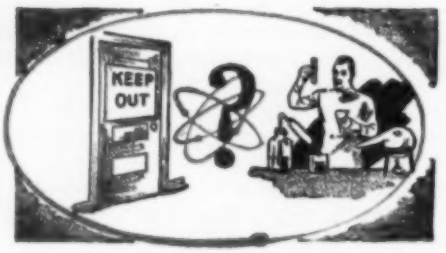
CIVILIAN VS. MILITARY

Because the atomic bomb is the world's greatest weapon, the armed forces would like to control it. But because atomic energy can also be used for peaceful, beneficial purposes, civilian control seems equally essential. These conflicting viewpoints had their strong proponents before the Congress which finally reached a fairly satisfactory compromise in the Atomic Energy Bill of 1946, setting up a competent civil board with which the armed forces will have continuing liaison. As we go to press, just before Year 2 of the Atomic Age begins, this bill has passed the Senate, but there is still a question how rapidly it will be enacted into law.



PRIVATE VS. PUBLIC

Atomic energy is "too big" and "too hot" to be handled privately. It must be nationalized and internationalized. The questions are *how* and *to what extent.* Fortunately, as the "boxes" on these pages show, there are means that may attain reasonable safety against misuse of the atom, and still do so without public control of many "non-dangerous" applications.



SECRECY VS. FREE SCIENCE

Throughout the first year of the Atomic Age hot debate has raged around "keeping the secret of the bomb." To prevent potential enemies from making atom bombs some have urged a complete blackout of all phases of atomic energy — even of the scientific fundamentals of nuclear physics. Others have sought immediate and complete disclosure of all bomb "secrets," both scientific and technological. These have held that such information cannot be effectively hidden, that secrecy blocks progress and breeds wars.

A year of debate has brought the great mass of vocal opinion to this middle ground: (1) Ease restrictions on the exchange of basic physical knowledge. (2) Release for industry's benefit many of the devices and methods developed for the bomb project. (3) Hold tight to specialized information on atomic bombs and bomb-material production until international safeguards are fully operative.

DOMESTIC CONTROL AS PLANNED IN THE ATOMIC ENERGY BILL OF 1946

McMahon Committee Bill contains the following provisions.

Policy. Declares it the policy of the U. S. to develop and utilize atomic energy to improve the public welfare, increase living standards, strengthen competitive enterprise and promote world peace.

Organization. Establishes the Atomic Energy Commission (AEC) of five administrators to direct four divisions on research, production, engineering, and military applications—to work in liaison with three committees from (1) the armed forces, (2) outstanding civilians, and (3) joint Congressional representatives.

Production. AEC to own and operate (under management contracts with industry if deemed desirable) all facilities for the production of fissionable materials, such products to be distributed with their radioactive byproducts under license for private industrial and medical research.

Military Application. AEC to engage in development work and produce atomic bombs as directed by the President, to be delivered only on his order to the Armed Forces.

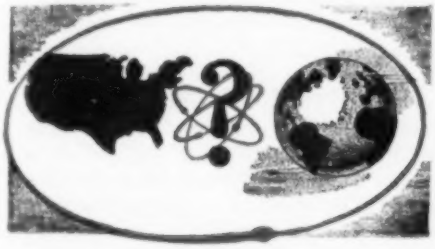
Industrial Utilization. Permits AEC to conduct research, design and manufacture equipment for atomic-energy utilization, license its use, produce and sell power obtained as a byproduct in the production of fissionable materials. Directs AEC to give widest safe scope to private initiative.

Control of Information. AEC to enforce a ban on the dissemination of restricted data that might be used to injure the U. S. or secure advantage to a foreign nation, yet to provide leeway for ultimately relaxing restrictions as future conditions warrant.

Patents and Inventions. No private patents permitted for production of fissionable materials or their utilization for military weapons, but AEC will justly compensate for such inventions, when made by private citizens. Patents for non-military applications may be purchased or condemned by the AEC only when public interest is affected.

Appropriations. "Such sums as may be necessary and appropriate to carry out the purposes and provisions of the act" *plus* unexpended funds of the Manhattan Engineer District.

...while Time runs out



NATIONAL VS. INTERNATIONAL

Born of nationalism, the Atomic Age began when three nations discovered a weapon that today gives them the greatest military power on earth. The prime question is: Shall the atom remain the servant of its conqueror, nationalism?

During Year 1 of the Atomic Age the Truman-Atlee-King declaration, the masterly report of the State Department's atomic consultants, and the U.S. representative on the United Nations Atomic Energy Commission, have all called for international control of atomic energy. Year 2 will start with no such control. This failure to decide and act is in part a natural result of the extreme difficulty of the problem and the obvious dangers of unwise decisions. Nations everywhere face a triple dilemma in this Atomic Year 2: the dangers of nationalism, the dangers of internationalism, the supreme danger of not being able to make any decision in time to meet the atomic bomb threat.

INTERNATIONAL CONTROL AS PROPOSED BY THE U.S. TO U.N. ATOMIC COMMISSION

Baruch statement follows constructive path laid out by Atomic Consultants in "Acheson-Lilienthal Report."

The Plan. The U.S. has proposed that all nations band together to outlaw the use of atomic energy for war and to promote and harness its development for the benefit of mankind. To this end an International Atomic Development Authority would be set up, and to it the U.S. would turn over, at various stages of its organization, all atomic bombs, know-how, raw materials, facilities, and stockpiles of fissionable material. Thus IADA eventually would supersede national authorities on some matters and supplement them on others.

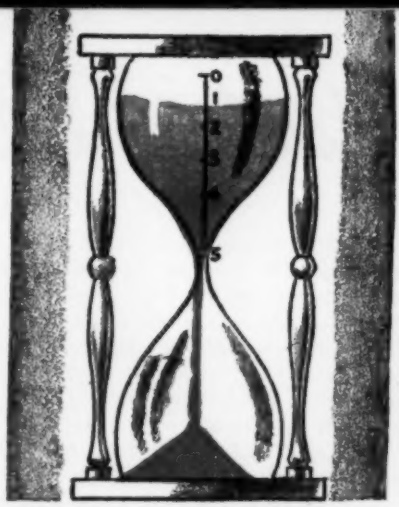
Owner and Operator. IADA would take over from national authorities or private ownership full management and control of all atomic energy matters that afford a possible threat to World security. These include:

1. Raw Materials—Supplies of uranium and thorium to be inventoried, controlled, and developed by IADA.
2. Facilities—IADA to control and operate plants producing fissionable materials and to own and control their products.
3. Research—IADA to undertake research and development on all aspects of atomic energy and to possess exclusive right of research on atomic explosives.

Private Initiative. Will have its chance to push forward the use of atomic energy for peacetime (non-dangerous) purposes. With IADA providing raw materials and carrying out necessary inspection, national and private enterprise may operate "safe" power piles, and produce and use radioactive isotopes for research, clinical and other applications. Radioactive isotopes produced by IADA also can be distributed for peacetime use.

The Mechanics of Safety. No plan is a certain guarantee against future atomic war. This plan should, however, prevent surprise attack with atomic weapons; for IADA is to buttress positive ownership or management controls with wide powers of inspection. Obviously, successful inspection rests on complete freedom of access or egress in any area.

Sanctions. At the heart of the plan lies the problem of penalty for violation — a matter for profound statecraft. To the U.S., one aspect of sanctions appears crystal clear: Here is an area where the veto right now held by the five great Powers must be redefined if it is not to be incompatible with the meaning and purpose of the proposed control.



Leading industrial nations can produce atomic bombs in five years, competent scientists announced after Hiroshima. Already one year of the precious five has been consumed in debate without international action. Soon it may be too late to check the growing momentum of the atomic arms race.

TIMETABLE—ATOM YEAR 1

1. **July 16, 1945. World's first atomic bomb detonated in New Mexico.**
2. **July 26, 1945. President Truman and Prime Minister Churchill issue Potsdam ultimatum threatening Japan's destruction if she continues.**
3. **August 6, 1945. Atomic bomb dropped on Hiroshima.**
4. **August 9, 1945. Atomic bomb hits Nagasaki.**
5. **August 11, 1945. Army releases Smyth Report on "Atomic Energy for Military Purposes."**
6. **August 14, 1945. Japan accepts terms of Potsdam declaration.**
7. **November 15, 1945. Truman-Atlee-King issue declaration of intention and procedures looking toward international control of atomic energy by United Nations.**
8. **March 28, 1946. State Department issues Acheson-Lilienthal Report on the "International Control of Atomic Energy."**
9. **April 12, 1946. Manhattan Engineer District announces program for experimental development of atomic power.**
10. **June 1, 1946. "Atomic Energy Bill of 1946" passes Senate unanimously, is referred to House of Representatives.**
11. **June 14, 1946. First meeting of United Nations Atomic Energy Commission (Bernard Baruch as American member). Manhattan District announces availability of radioactive isotopes for research use.**
12. **July 1946. Joint Army-Navy tests of atomic bombs at Bikini.**

...but if Man Masters Atom...

IF MUTUAL DESTRUCTION by the atomic bomb can be avoided, the first century of the atomic age will bring immense advances in scientific knowledge, health and living standards. Already many prospective benefits can be outlined, but those we can neither foresee nor suspect may be even more important.

This prediction is grounded in scientific experience; the most fundamental discoveries have always been the most fruitful. The study of molecules gave us chemistry. Faraday's experiments with electricity and magnetism are the foundation stones of the great electrical industry. Can one expect any less from an understanding of the heart of every atom?

BENEFITS

Atom-splitting benefits clearly visible today fall mainly in three classes: (1) heat and power applications of the uranium piles; (2) general industrial applications of equipment and methods originally developed for the bomb project; (3) chemical, biological and medical uses of the "tagged atoms" (radioactive isotopes) now abundantly available from pile operation.

It is now evident that the energy yield of the U235 in an atomic pile can be multiplied many times by returning to (or leaving in) the pile the plutonium and possibly the U233 produced respectively from the U238 and the thorium in the pile. This is an indirect way to "burn" inexpensive U238 and thorium, and thus greatly extend the supply and reduce the cost of atomic fuels.

POWER APPLICATIONS

Although present piles run at low temperatures, it is certain that temperatures high enough for the efficient operation of steam and gas turbines will be attained. Already an experimental atomic power plant has been ordered. Atomic power for certain remote installations (say, for heating Arctic airports) may not be far off.

In five or ten years uranium piles will be driving a few experimental ships and submarines. In 20 or 30 years uranium may begin to compete widely with coal as a fuel for suitably situated large central heating and power plants. The 50-ton minimum weight of shielding rules out nuclear power for automobiles and small piloted planes.

SPECIAL USES

Some day ultra-high temperatures from splitting atoms will be used for special industrial operations on metals and other materials. Even the dread atomic bomb might easily serve peaceful ends — blasting lakes in deserts, changing the course of rivers, leveling mountains.

INDUSTRIAL BYPRODUCTS

The special industrial equipment and methods developed for the bomb project will find hundreds of important uses — mostly for purposes unrelated to atomic energy. These developments include pumps with neither seals nor leaks, leak detectors of amazing sensitivity, ultratight welding, a portable mass spectograph for quick and automatic gas analysis, new ways of handling corrosive and poisonous materials, new diffusion barriers for the separation of gases and of petroleum products.

TAGGED ATOMS

Yet more important than any of these, in the long run, will be the hundreds of radioactive isotopes now available as by-products of pile operation. Chemically indistinguishable from the ordinary forms of the elements, these isotopes serve as tagged atoms or "spies" if mixed with common stable atoms of the same species. They "fly with the flock," and can later be identified as surely as banded birds. With these amazing tools of research, the course of any element or compound may be traced through the bodies of men, animals and plants. Similarly, tagged atoms may be used in studying the course of many kinds of industrial and chemical operations.

BIOLOGY AND MEDICINE

A suspected hyperthyroid condition can be diagnosed by feeding the patient a minute measured amount of radioactive iodine. The click of a "Geiger" counter placed on the patient's neck will tell (1) what percentage of the swallowed iodine concentrates in the thyroid cells and (2) how rapidly that concentration is accomplished — giving a definite indication of the state of the gland.

In similar fashion the radioactive isotopes of hydrogen, oxygen and carbon will trace out the intricate transformations of carbohydrates and proteins in the human body. Radioactive phosphorus will explore the bones. Radioactive iron will show how and where blood cells are formed. Radioactive sodium will time the circulation of blood.

USES IN INDUSTRY

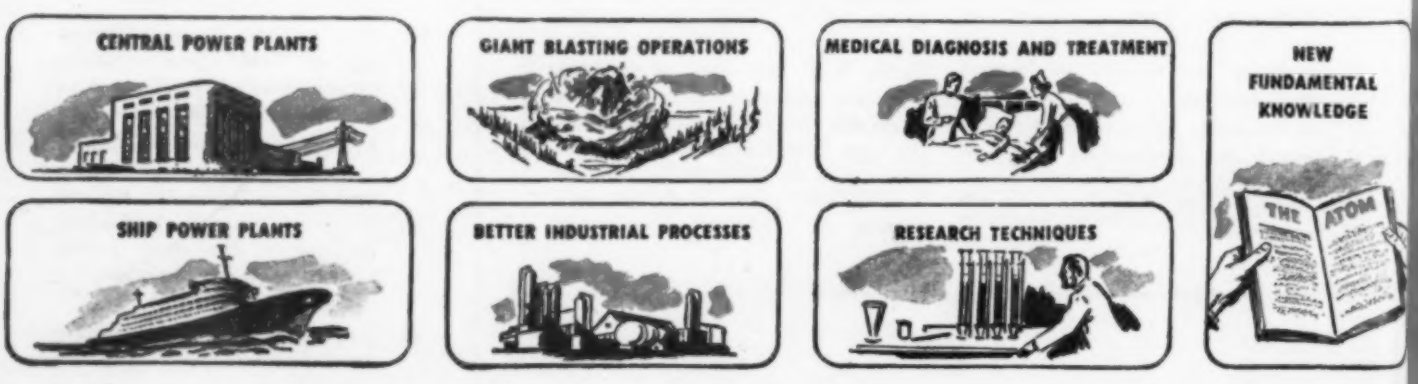
In chemistry the radioactive isotopes will speed the understanding of metallurgical and organic reactions. In industry they will measure flow, detect leaks, and do other useful work.

Meanwhile the uranium piles will be manufacturing certain radioactive isotopes that can serve as cheap but effective substitutes for high-cost medical radium.

KNOWLEDGE COMES FIRST

It is already clear that the chief benefits of atom splitting will come first as new scientific knowledge rather than as new engines and gadgets. But in the long run man's new understanding of the inner atom will enrich the whole range of human activity. This has always been the case with less fundamental discoveries in science. It can hardly be less with this most fundamental discovery.

ATOM SPLITTING WILL SERVE MAN IN:



CHEMICAL
& Metallurgical
ENGINEERING

ESTABLISHED 1902 JULY 1946 SIDNEY D. KIRKPATRICK, Editor

BIKINI BYPRODUCTS

AN entirely unsuspected byproduct of the A-bomb has developed abroad the USS Panamint that is carrying United Nations representatives and American scientific and military observers to Bikini. We stopped at Kwajalein today for our final briefing and incidentally picked up some airborne supercargo—more than two score Senators, Congressmen and high ranking airmen. They are to be with us for an indefinite period—at least until after the first test is made and evaluated. As they came on board and casually took over our choicest accommodations one of the Dutch scientists remarked "It's too bad we have to make room for these 'foreigners' because we 'scientists' have been having such a happy time together."

In other words in a few weeks of close association aboard this good ship we have accomplished something on which the high and mighty statesmen of the world will spend many months and maybe years in formal debate and diplomatic negotiations. If they are fortunate enough to arrive eventually at the same mutual understanding and respect that has characterized our less formal discussions here, there is real hope for the United Nations.

But it will take time as well as sympathetic understanding to arrive at such a meeting of minds. At the start all of us were inclined to regard each other with some suspicion. Whenever we found a nation to be represented by both a scientist and a militarist we were certain that the latter was there as part of a Gestapo to spy as much on his fellow countryman as on the delegations from other nations. Gradually, however, we realized that there was no basis for such mistrust. All aboard entered enthusiastically into all our activities and all on even ground. Tory and Labor Party representatives from the British Parliament shared in the same amateur hour program with the Russian professor, the Egyptian colonel, the Chinese general and the distinguished physicists from France and Poland. Likewise in more serious sessions when scientific subjects came up for discussion there has been no holding back of facts and figures that would help to advance our common interests in the forthcoming tests. Our genial Mexican professor of many talents sang Pagliacci last night with the same skill and vigor that he set us right a few days ago on methods of measuring explosive impact and distortion. Our physical chemist from Midland, Mich., has devoted his great inventive genius to a wide range of problems from the use of magnesium as a protective electrode to prevent corrosion, to the organization and production of a common pool of photographs. Others of us from a dozen nations share in a plan for supplementing our daily mimeographed newspaper *The Panamint Press* with a more elaborate souvenir volume.

By the time this reaches *Chem. & Met.* readers the whole world will know at least the preliminary results of this great experiment. Meanwhile we feel confident that whatever happens later at Bikini, its preparation has already contributed something toward a solution of the world's most serious problem—Peace through mutual understanding and respect.

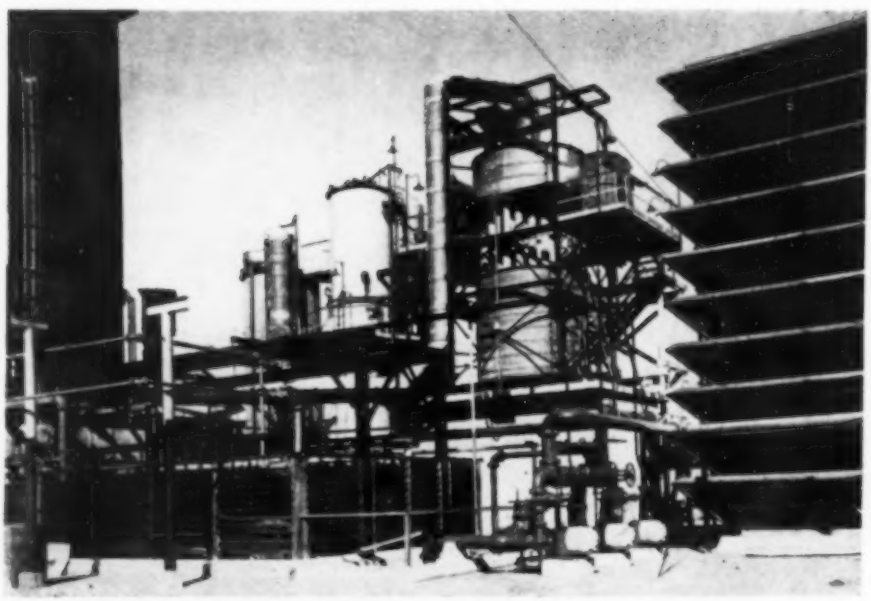
Sidney D. Kirkpatrick

Kwajalein
June 28, 1946

JAMES A. LEE *Managing Editor, Chemical & Metallurgical Engineering*

Recovering Alkylation SPENT ACID

This article describes one of three contact sulphuric acid plants that were built during the war to convert spent acid from the sulphuric acid alkylation process to strong pure acid. Its principal feature of novelty compared with sulphuric acid plants operating on sulphur alone is a furnace in which the spent acid can be broken down to SO_2 at high temperature, brought about by using combustion air preheated in a recuperator, and usually auxiliary fuel gas as well. Sulphur can be burned simultaneously or alone if acid is not being recovered.—*Editors*



Reclaiming of 98 percent sulphuric acid from alkylation spent acid in Houston plant of Consolidated Chemical Industries

ALKYLATION spent acid is a waste product from the alkylation process of producing high octane gasoline when using sulphuric acid as the catalyst. This spent acid varies in character with the products treated and with the procedure used by the refineries. On the average, the spent acid contains by weight; acid, 85 to 90 percent; water, 2 to 4 percent, and hydrocarbons 6 to 10 percent. It is black in color and fluid at atmospheric temperatures.

Reclaiming of 98 Percent strength sulphuric acid from this alkylation spent acid is being done by three organizations on the Gulf Coast, one of which is the Consolidated Chemical Industries at its Houston, Tex., plant. Alkylation spent acid when decomposed at high temperature will break down into its components, SO_2, H_2O, and O_2. In the Chemical Construction Corp.'s process, in use in this plant, the alkylation spent acid is sprayed into a specially designed furnace maintained at high temperature by means of auxiliary gas. The acid is decomposed and the hydrocarbon content supplies part of the fuel required to maintain the high temperature. The hot gases pass through a heat recuperator that serves to preheat the air used for combustion while the combustion gases are partially cooled, cleared of acid mist by means of a Cottrell precipitator and then dried and processed in the contact sulphuric acid plant to full strength 98 to 99 percent sulphuric acid. In as much as the acid is completely decomposed into its components and all hydrocarbons burned, the acid from this process is as clean as acid made directly from sulphur and therefore suitable for all purposes.

This Houston plant was designed for a capacity of 87.5 tons (100 percent acid basis) per day, but over a long period has averaged 104 tons of water white acid. One or two men per shift operate the plant.

The over-all efficiency of the plant from spent acid to new acid is approximately 93 percent. The efficiency of the converters from SO_2 to SO_3 is about 96 percent. In addition, the recovery of H_2SO_4 in the alkylation plant averages 95 to 97 percent of the new acid charged.

At the time the plant was visited the spent alkylation acid being processed contained about 85 percent H_2SO_4, 12 percent carbonaceous matter and 3 percent water. With this type of feed a small amount of fuel gas was required. By blending small quantities of acid sludges of somewhat higher hydrocarbon content, as for example naphtha sludges, combustion can be made self supporting and the cost of fuel gas eliminated.

Briefly, the "Chemico" process consists of spraying the spent acid into a furnace where it is decomposed to form sulphur dioxide at a temperature of approximately 2,200 deg. F. Hydrocarbons in the sludge, with the addition of gaseous fuel (if needed), furnish the heat required in the process. Gases leaving the furnace pass through a recuperator where heat is recovered by preheating the air entering the furnace. The hot gases are then scrubbed with acid and cooled by direct contact with water. Sulphur dioxide in the water leaving the tower is recovered by stripping with air. Sulphuric acid mist is removed in an electric mist precipitator operating at 80,000 volts. Water vapor is removed by scrubbing with sulphuric acid in a drying tower. The circulating acid is cooled in a suitable cooling system. A centrifugal blower is located after the drying

tower to propel the gases through the system. The SO_2 gases are then preheated and converted to SO_3 by passing through layers of vanadium catalyst. The hot gases leaving the catalyst layers are used to preheat the incoming SO_2. The SO_3 leaving the converters is absorbed in strong sulphuric acid where it combines with water to form 98 to 99 percent H_2SO_4. The acid is cooled in a suitable cooling system. Acid lost in the alkylation and regeneration cycles can be made up by burning sulphur or hydrogen sulphide in the combustion furnace.

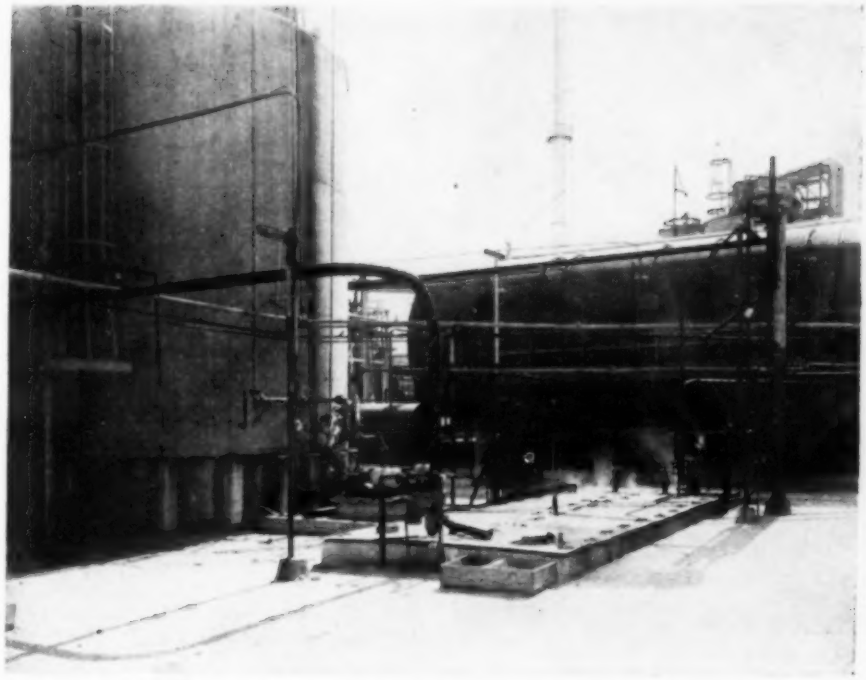
The Houston plant is advantageously located near several large petroleum refineries. On arriving at the plant the spent alkylation acid is stored in a covered steel tank. It is pumped directly into the decomposing furnace consisting of a brick-lined steel shell and sprayer by using a "spinning cup" burner. This burner produces a thin film of acid by means of centrifugal force. The film is broken into a fine spray by means of compressed air. Fuel gas, when used, is admitted concentrically around the acid burner to provide additional heat required for the process. Three Maxon Premix burners are also installed radially around the furnace. Most of the gas requirements should be introduced in the concentric burner.

It is sometimes advisable to produce more acid than can be recovered from spent acid in order to overcome losses in the alkylation and regeneration cycles. In such a case, molten sulphur from the melting pit is also sprayed into the furnace and burned. This sulphur supplies the necessary additional SO_2 and at the same time provides part of the heat required for decomposition of the spent acid. It is not necessary, however, to burn sulphur unless it is desired to increase the acid production.

Air is admitted at the front of the furnace, around the acid burner. A silicon carbide tubular heat exchanger of the Fitch recuperator type is used to preheat this air to about 1,700 deg. F. by means of the heat in the exit gases from decomposer furnace previously mentioned.

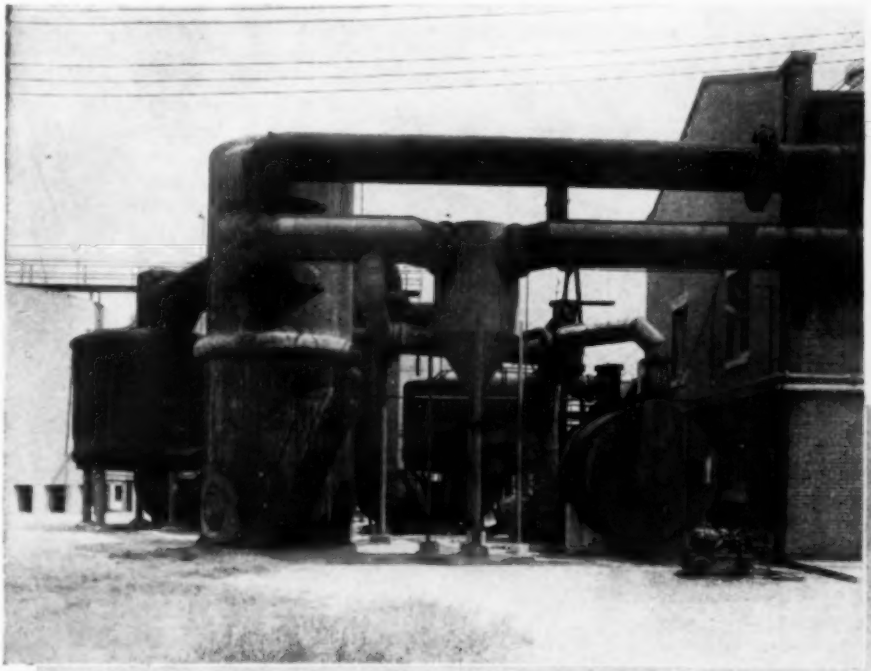
An air fan is provided for use in starting up the furnace, at which time the furnace is under a slight pressure with discharge gases going to the atmosphere through the scrubber tower. Acid must be circulated over this tower. During normal operation the furnace is under a slight vacuum and the fan is used to overcome some of the pressure loss in the recuperator.

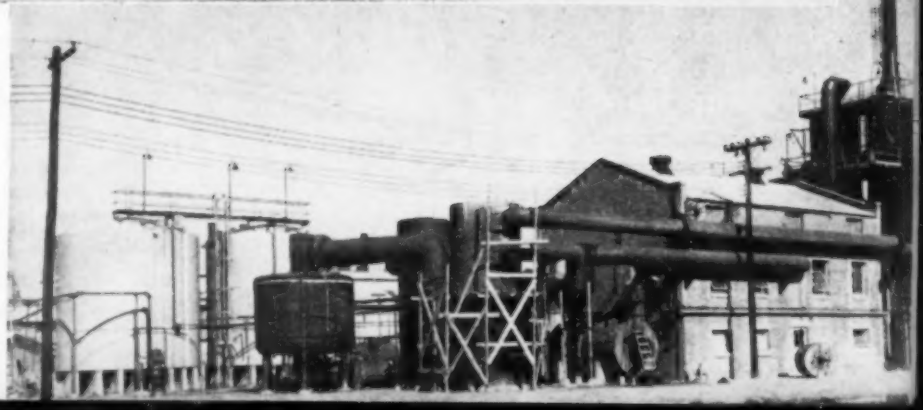
The furnace was designed to operate at a temperature of 1,900 to 2,300 deg. F. with preheated air of 1,600 to 1,700 deg. F. but was operating at 2,000 deg. when visited. The oxygen content of the gas leaving the furnace should not fall appreciably below 6 percent of oxygen by volume (dry basis). Under these conditions, all of the H_2SO_4 is reduced to SO_2 with a negligible amount of SO_3. Operation at lower temperatures would be advantageous since it would reduce fuel costs, furnace maintenance costs, etc., and

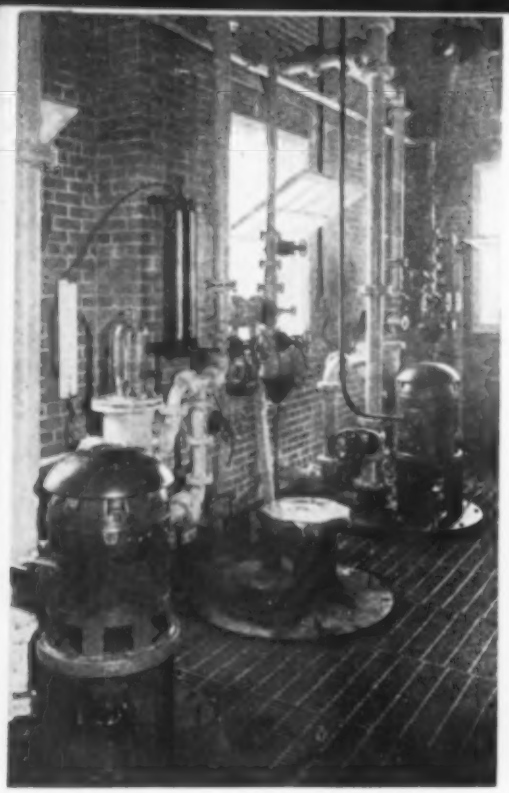


Sulphur melting pit in foreground, sludge storage tanks and pumps on left and furnace on right

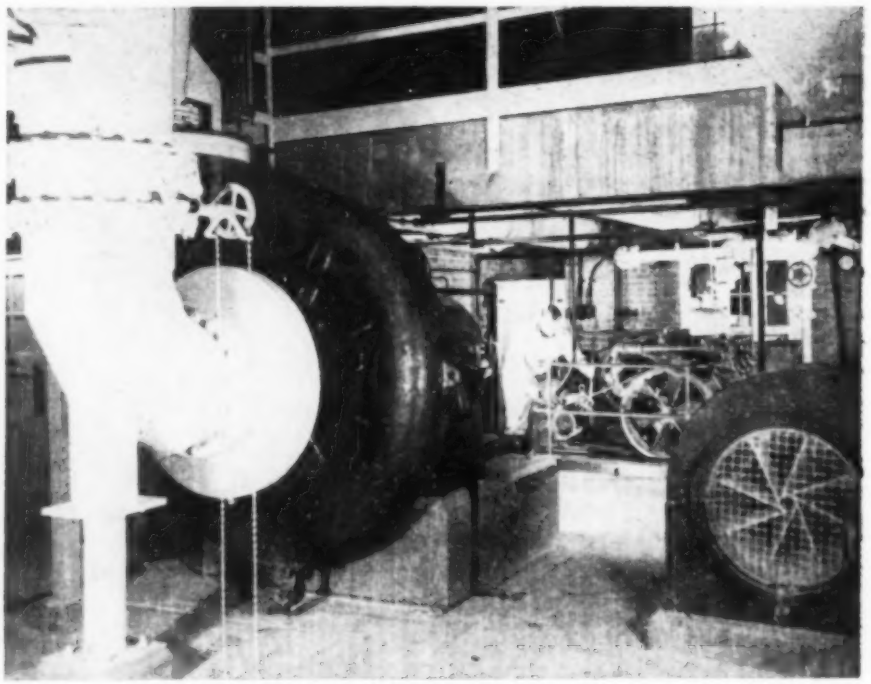
Converters and heat exchangers used for preheating and conversion of sulphur dioxide gases to sulphur trioxide. Hot gases leaving vanadium catalyst are used to preheat incoming sulphur dioxide







Vertical sulphuric acid circulating pumps and piping interconnecting 98 and 93 percent acid systems



Main blower for handling sulphur dioxide gases is on left foreground. Air compressor appears in rear, and recuperator blower on right

would allow operation with a higher percentage of SO_2 in the exit gases. However, if the temperature is reduced below 1,900 to 2,000 deg. F., the decomposition will be incomplete.

Hydrogen sulphide, mercaptans, waste SO_2 gases, etc., can be burned in the furnace, if available, and their sulphur content converted into sulphuric acid.

The recuperator is not gas-tight and there is a tendency for some air (20 percent) to leak into the SO_2 gas stream. For this reason it is important to balance the pressure on the system properly so as to attain a minimum pressure drop through the recuperator. This is easily kept at a minimum by careful treatment. In a more recent design excessive leakage has been prevented.

Molten sulphur is kept at the temperature for best atomization (275 deg. F.) and is pumped into the furnace through a sulphur burner, by means of steam-driven centrifugal sulphur pumps. Care is taken to see that there is sufficient air for the amount of sulphur (and other fuels) being burned, as lack of air would tend to cause sublimation of the sulphur.

Gases leaving the recuperator enter a scrubbing tower, a steel shell lined with sheet lead and acidproof masonry and packed with spiral rings, at about 1,120 deg. F. and are cooled by direct contact with recirculated liquor to approximately 200 to 250 deg. F. Sulphuric acid of 46 to 60 deg. Bè. is used as the recirculating liquor. This liquor is cooled by means of cooling water flowing through lead coils immersed in lead cooling tanks.

Sulphuric acid mist which might be formed in the process is partially removed in the scrubbing tower. Mist recovered by the mist precipitator is also returned to the weak acid cooling tanks for recirculation. The concentration of the acid on the scrubber towers can be controlled by applying more or less cooling on the circulation system. The higher the temperature the higher the concentration of the circulating acid.

When the quantity of acid in the cooling tanks increases, it is removed from time to time by adding to the 93 percent drying tower as drip acid. If the gases from the decomposing furnace contain too much SO_3, or if the circulating liquor is too weak, or both, there may be an excess of water to take care of which may lead to waste of acid.

TOWER

Acid is circulated over the tower at all times in order to cool the gases and prevent damage to the lead work, and simultaneously to clean it of any dust or other foreign matter which might be carried over from the furnace or recuperator.

Gases are further cooled to 100 deg. F. in a cooling tower, similar in construction to the scrubbing tower except that this tower is not packed. Fresh water is sprayed directly into this tower to cool and condense water vapor from the gases. This water is fresh, clean and reasonably free from chlorine, H_2S and salts.

Hot water leaving the tower is saturated with SO_2 and contains traces of H_2SO_4. This water goes to a distributing box from which it is pumped over the stripping tower, a lead-lined steel shell packed with spiral rings. Air is drawn through the stripping tower by means of the suction on the system. This air strips the SO_2 from the hot water and returns the SO_2-air mixture to the cooling tower. Water containing a trace of SO_2 discharges from the stripping tower directly to the sewer.

Gases from the cooling tower contain a small amount of sulphuric acid as a fine mist which must be removed before the SO_2 gases can be converted to SO_3. This mist results from the presence of small amounts of SO_3 in the gas stream leaving the combustion chamber. The physical nature of this mist is such that it cannot be removed by scrubbing.

A Cottrell electric mist precipitator is provided to remove this mist before it enters the drying tower. The electrostatic charge on the mist particles causes them to travel toward the positive electrode and collect on the side walls of the tubes. The resulting weak acid solution runs down the tube walls and out of the precipitator through a sealed boot. It flows by gravity into the scrubbing tower cooler tanks.

Clean gases leaving the precipitator are saturated with water vapor and next pass into a drying tower, a steel shell lined with acidproof masonry and packed with spiral rings. Here the moisture is removed from the gases by absorption in 93 percent sulphuric acid which is circulated over the tower from a pump tank consisting of an acidproof masonry lined steel shell and submerged pump. The acid discharges by gravity from the drying tower and passes through cast iron cooling coils connected by cast iron lines to the pump tanks. Water sprayed over

the surface of these coolers removes the heat generated by the absorption of the water vapor in the strong acid. Part of the acid circulated over the drying tower is withdrawn continuously and simultaneously replaced by stronger 98 percent acid sufficient to maintain the strength of the circulating acid constant at 93 percent.

Air sufficient to dilute the SO_3 content of the gases to about 8 percent is also admitted at the drying tower and the entire volume of gas passes through a centrifugal blower-exhauster located in the system after the drying tower. This blower maintains the entire purification system previously described under a slight vacuum and delivers the gases under pressure to the primary and secondary heat exchangers.

In order to obtain a gas of the highest possible dryness, the following points are of importance:

1. The temperature of acid circulated over the drying tower is kept as low as possible, preferably 75 to 85 deg. F. However, in summer the temperature may go as high as 105 deg. F., all depending upon the cooling water available.

2. The strength of the circulation acid should be kept as uniform as possible; 93 percent strength has been found to be desirable for drying purposes. It is also possible to utilize a stronger acid. In this case mist formation is likely to occur if the strength is accidentally allowed to exceed 98 percent.

3. The acid distribution over the tower must be even and a proper amount of acid must be pumped over the tower at all times.

CONVERSION

In the heat exchangers the gases are heated to 800 deg. F. before entering the primary converter. In general, the lowest converter entrance temperature possible, but still maintaining the entrance to contact mass above 800 deg. F. will give the highest conversion efficiency.

Two tray converters are arranged in series with a heat exchanger in between for control of temperature. In the primary converter SO_2 oxidizes to SO_3 producing heat which raises the temperature of the gas mixture rapidly to about 1,100 deg. F. After leaving the contact masses in the first converter, the gases are cooled to 800 deg. F. by passing through the hot side of the secondary heat exchanger where heat is given up to the SO_2-air mixture before it enters the primary converter. This cooling is of importance in order to finish up the reaction and obtain the highest possible yield.

The gases then enter the secondary converter where any residual unoxidized SO_2 is converted to SO_3. This secondary conversion produces additional heat, raising the gas mixture to 860 deg. F. The gases are then passed through the hot side of the primary heat exchanger where heat is transferred to the incoming cold SO_2-air mixture, and are thereby cooled to 475 deg. F. before entering the absorption tower. A small quantity of sulphuric acid is condensed and drained off from time to time.

The absorption tower consists of a steel shell lined with acidproof masonry and packed with spiral rings. The SO_3 in the gas stream is completely absorbed in 98 percent sulphuric acid which is circulated over the tower from the strong acid pump tank and 98 percent acid cooler. Part of the 98 percent acid produced in the absorption tower is delivered continuously to the drying tower to maintain the strength of drying acid at 93 percent, and the 93 percent acid withdrawn from the drying tower is mixed with the absorbing acid which provides part of the water required for the formation of H_2SO_4 from SO_3. The remainder of this required water is introduced directly into the absorbing acid. Clean water-white acid produced is continuously bled off the circulating stream and stored in steel tanks.

For a pictured and diagrammatic flowsheet of this process the reader is referred to pages 138-141.

Houston plant of Consolidated Chemical Industries. Spent acid regeneration unit is in lower right

RICHARD W. PORTER *Assistant Editor, Chemical & Metallurgical Engineering*

FLUORINE PRODUCTION

Paves Way for New Chemical Industry

Fluorine is now ready. Production of this versatile element marks a milestone in the history of the electrochemical industry. Of greater significance, it opens the door to more intensive research and development of products and processes heretofore impossible or impractical.—*Editors*

Long a pioneer in the development of the fluorine chemicals, the Pennsylvania Salt Manufacturing Co. has again set the pace with its pilot plant production of pure elemental fluorine. Leading the way in 1931 as the first commercial producer of anhydrous hydrofluoric acid, this company has been a potent force in making fluorine chemicals one of the most important tools of recent wartime production (see *Chem. & Met.*, March 1945, pp. 94-99).

One of the most active of chemical elements, fluorine defied all attempts at isolation until 1886 when Moissan, a French chemist, electrolyzed a solution of anhydrous hydrofluoric acid in potassium fluoride to produce elemental fluorine. In subsequent years progress was slow and fluorine has been little more than a laboratory curiosity due to its extreme chemical activity which made it difficult to handle and dangerous to use. Paradoxically enough, it is the unusual stability of many of its compounds that makes such fluorine chemicals as Freon (difluorodichloromethane) and the new Du Pont plastic Teflon (tetrafluoroethylene) so valuable.

Despite tremendous gains, however, fluorine chemistry is but at the threshold of its possibilities. With the production of elemental fluorine, the time is ripe for development of a whole new field of chemical industry which might well parallel that of its sister element chlorine. New methods and new techniques in working with fluorine should go far toward boosting its use in many processes.

Basically, the electrochemical method is the only practical way in which fluorine can be produced. Along this line Pennsalt after several years of experimental work, has evolved an electrolytic cell which has been operated successfully for some time to produce fluorine of high purity. This pilot plant cell, a prototype of future large capacity cells, seems to meet the requirements for economical commercial operation.

THE FLUORINE CELL

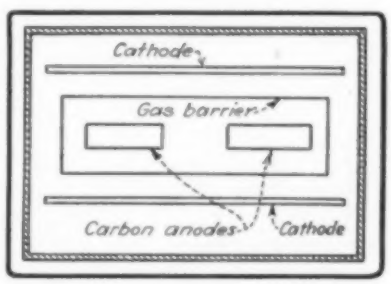
Capable of producing several pounds of fluorine per day, this cell is comprised essentially of a rectangularly shaped jacketed vessel of welded steel construction with an airtight removable cover (see Figs. 1 and 2). From the cover are suspended two carbon anodes, two steel cathodes and a steel gas barrier. A standard grade of low-carbon steel resists corrosion and is used throughout. Carbon is the only satisfactory anode material. Nickel anodes suffer excessive corrosion while graphite disintegrates rapidly.

Anodes and gas barrier are insulated from each other and also from the cathode which is electrically connected to the cell body. The barrier, a sheet steel skirt, surrounds the anodes and extends below the surface of the electrolyte to keep separate the products of electrolysis. Anolyte and catholyte mix freely in the cell, no diaphragm being necessary.

Operating normally at 9 to 10 v. and 250 amp., the cell can handle a fairly high overload. Current efficiency is well above 90 percent. However, large electrode overvoltages, as well as electrolyte resistance, reduce the over-all power efficiency to a low value. Actually, the energy requirement calculated for the cell reaction, $2HF \rightarrow H_2 + F_2$, would be equivalent to a theoretical voltage considerably lower than the 9 to 10 v. observed.

Electrolyte is made up of a solution of AHF (anhydrous hydrofluoric acid) in fused KHF_2 (potassium bifluoride), with a composition of 40 percent AHF by weight. Solid KHF_2, charged into the cell, is heated to about 95 deg. C. by steam in the cell jacket but it remains solid until the addition of AHF lowers the melting point of the mixture. At a concentration of 40 percent AHF the melting point of the mixture is 72 deg. C. (see Fig. 3).

When electrolysis begins, HF dissociates to form fluorine gas at the anode and hydro-



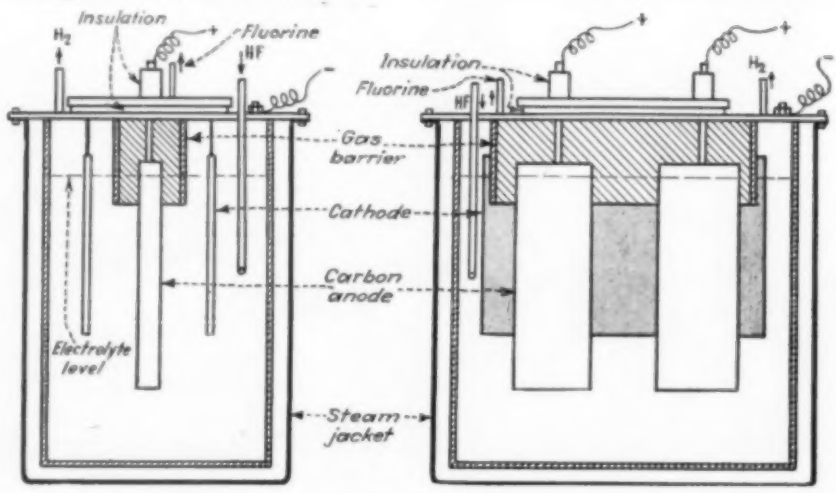
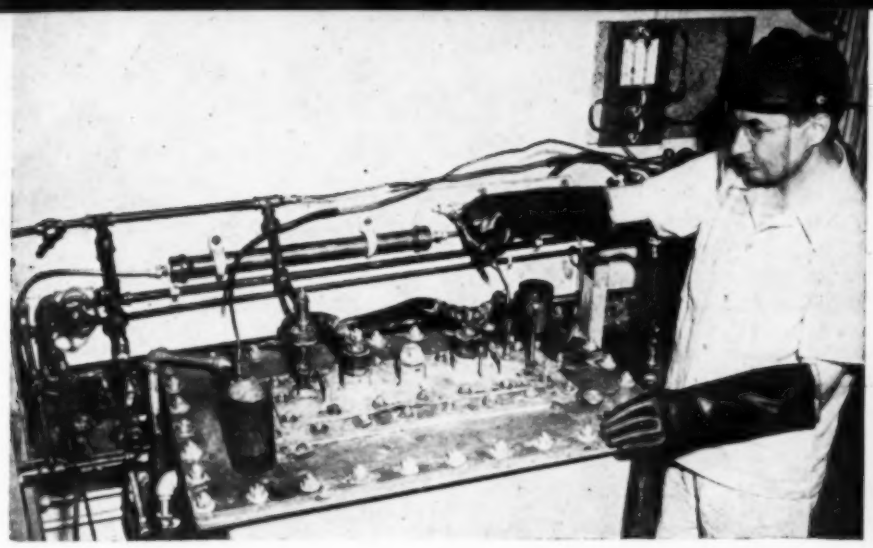


Fig. 1—Schematic diagrams illustrating Pennsalt's new fluorine cell



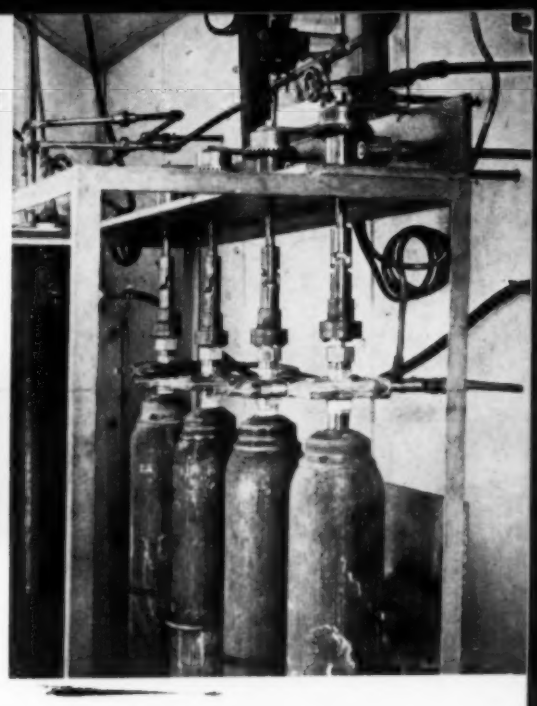


Fig. 2, Above—Fluorine gas is formed on the carbon anode of this cell by the electrolysis of a solution of AHF in fused KHF_2; Fig. 4, Right—Remotely controlled from behind a ½ in. iron wall, these steel cylinders are filled with about ½ lb. of fluorine at 400 lb. per sq. in. pressure

gen at the cathode. Kept separate by the barrier, these products are discharged continuously. As the electrolyte is depleted of hydrogen and fluoride ions, it is regenerated, either continuously or intermittently, by addition of AHF.

Both the fluorine and hydrogen contain about 5 percent by weight of HF and less than 1 percent of other impurities. These may be comprised of atmospheric gases and, to a lesser degree, of oxygen fluoride formed from traces of moisture which may enter with the HF feed. Carbon tetrafluoride does not seem to be present in any significant quantity. Fluorine is purified by removing the HF either by absorbing it in sodium fluoride or by chilling. After purification the fluorine gas is used directly or is compressed and filled in special cylinders for storing and shipping. For some applications, such as direct fluorination of hydrocarbons, HF is not an objectionable impurity and the cell gas may be used without purification. The cathode product, hydrogen, is discarded but in commercial operation the HF would be recovered.

BASIC CONSIDERATIONS

A discussion of fluorine production is aided by considering the work of Cady (*J.A.C.S.* 56, 1431, 1934) in his study of melting points and vapor pressures of the system KF-HF. He showed (see Fig. 3) that there are three regions of temperature and HF concentration suitable for electrolysis to produce fluorine. In each of these regions the system is liquid and the vapor pressure within practical limits. Excess HF loss occurs if this exceeds 5 cm. Hg.

The low temperature region was used by Moissan but has the disadvantage of requiring a temperature below —30 deg. C. which is hard to maintain. Here, also, it appears necessary to use noble metal electrodes. The high temperature region is reported to have been used on a commercial scale in Germany during the war. A temperature of about 250 deg. C. is necessary and close control is required since the permissible range of composition and temperature must be held within narrow limits. In this case, however, it is possible to use graphite anodes which have better electrical and mechanical properties than carbon.

Commercially, the region in the middle temperature range is considered to have the best characteristics and is the one used by Pennsalt. Operating temperature is convenient to maintain and less rigid control is required because of the fairly wide range of composition and temperature in which it is possible to operate.

CRITICAL FACTORS

Perhaps the most important process variable is composition of the electrolyte. It is controlled by addition of AHF using liquid level as a guide with an occasional check by chemical analysis. Since only HF is consumed, it is the only variable which will cause changes in liquid level. AHF is thus added to the melt at a rate necessary to compensate for dissociation. Rapid absorption of the AHF in the melt occurs and thorough mixing is aided by the gas lift at the electrodes. No other agitation is required.

Electrolyte composition is maintained within the limits of 38 to 40 percent AHF. This is important. If the concentration of HF is allowed to rise, the vapor pressure increases, causing undue loss of HF, both in the fluorine and hydrogen. On the other hand, if the concentration of HF is low, the melting point of the electrolyte may rise to the temperature at which solidification begins (see Fig. 3).

Another critical factor in cell operation is temperature. While the cell will operate within fairly wide temperature limits it is desirable to control it rather closely to attain uniform, efficient operation. Here the temperature is held in the neighborhood of 95 deg. C. Although at the start of operation the cell must be heated to fuse the electrolyte, once electrolysis has begun, sufficient heat is generated to require cooling of the cell by circulating water through the cell jacket instead of steam.

Actually, the exact temperature of operation for a particular cell design depends on a number of factors. Again it is a question of economics. Generally, a higher temperature is desirable from the standpoint of cell efficiency. This increases conductivity so that a lower voltage may be used and less power consumed. Conversely, however, higher temperatures increase the vapor pressure of the electrolyte, causing increased evaporation of HF with consequent loss. Cell design, current efficiency, HF losses,

Fig. 3—Shaded areas, bounded by the melting point curve and the 5 cm. Hg pressure curve, indicate the three regions of temperature and composition in which electrochemical production of fluorine may take place; middle zone is used by Pennsalt in the recently developed cell

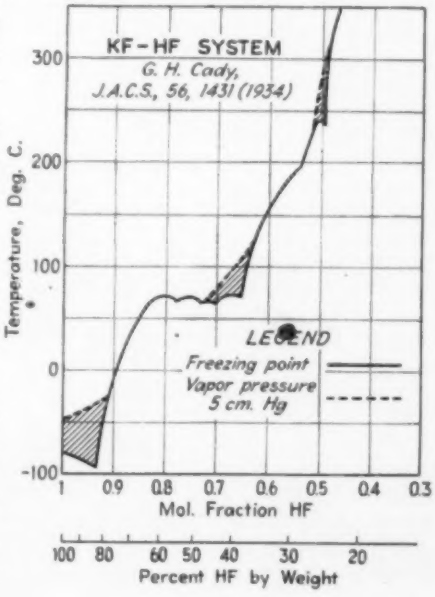


Fig. 5—Observing the compressing and filling operation through a 2 in. thick bulletproof sight glass

and cost of heating or cooling all enter the picture.

Relatively pure raw materials are necessary to insure uniform trouble free operations and a high purity product. Moisture, in particular, causes difficulty because it electrolyzes to form O_2 or F_2O (oxygen fluoride) and may also contribute to the "anode effect." Tentative raw material specifications which have proved satisfactory at Pennsalt are given herein.

The following maximum percentages of impurities in KHF_2 (potassium bifluoride) are permitted: K_2SiF_6—0.2, SO_4—0.1, Cl—0.05, H_2O—0.05 percent maximum loss in 1 hr. at 100 deg. C.

Even more important is the purity of AHF. Since this is consumed by electrolysis, concentration of impurities may build up in the electrolyte. Maximum allowable impurities are as follows in percent: H_2SiF_6—0.1, SO_2—0.06, H_2SO_4—0.004, H_2O—0.2.

TROUBLE SHOOTING

A common difficulty in many electrochemical operations employing fused salt electrolytes is also observed in the fluorine cell. The "anode effect," or "polarization" as it is often called, results from a spreading film of fluorine gas over the surface of the carbon anode which prevents the anode from functioning. It causes a sudden increase in cell voltage and a decrease in cell current. This phenomenon is not wholly understood but appears to be correlated with a critical range of moisture content in the electrolyte. The "anode effect" is most serious in an intermittent operation but where a cell operates continuously using a strictly anhydrous grade of electrolyte it is of little consequence. When the "anode effect" does occur, it may be overcome by temporary substitution of a nickel anode for the carbon anode.

The gas barrier, which normally "floats" in an electrically neutral condition between anode and cathode, must be checked frequently against insulation failure by measuring the voltage between it and each of the electrodes. If the insulation between barrier and cathode fails, the steel barrier acts as a cathode with the result that hydrogen may be generated in the fluorine zone causing the two liberated gases to recombine explosively. Severe corrosion may occur if the insulation between barrier and the anode should fail.

Under proper conditions, operation of the fluorine cell is smooth and without hazard. However, faulty operations may cause explosions of varying degrees of intensity. Thus, the failure of the cathode-barrier insulation, as noted above, may produce a continuous crackling sound as the gases recombine. Excess back pressure in the fluorine line may force the gas beneath the barrier into the hydrogen zone, producing heavy, rumbling explosions. The most severe explosions will result from leakage of air into the hydrogen zone and ignition of the mixture by stray bubbles of fluorine. To prevent damage to the cell in the event of an unusually severe explosion, emergency plugs are installed in the cell cover to relieve excess pressure.

CONSTRUCTION MATERIALS

Fluorine can be handled at atmospheric or moderately elevated temperatures in several metals with little or no corrosion. These include iron (low carbon steel), copper, magnesium, nickel and Monel. In these materials, an adherent fluoride film appears to give the necessary protection to the metal surface. The gas is piped in steel or copper but valve seats and stems, where abrasion occurs, are preferably made of Monel. Certain plastics have been found valuable as packing and gasket material. Carbon anodes are not noticeably eroded by the electrolysis but sometimes fail by cracking or splitting. Graphite and nickel anodes, as previously pointed out, are unsatisfactory in this work.

One of the major problems confronted was that of developing suitable containers for storing and shipping fluorine. Finally adopted were steel cylinders using a special valve packing material. These contain about ½ lb. of fluorine at 400 lb. per sq. in. pressure in accordance with ICC regulations.

Purified gas is compressed into the cylinders behind a ½ in. thick steel barrier through which the operation is remotely controlled (see Figs. 4 & 5). This barrier is fitted with a sight window of 2 in. thick bulletproof glass covered on the inside with Plexiglas to protect the glass from etching. The reason for special precaution is to protect the operator from direct impact of any possible explosions which might occur. This was especially necessary during the early stages of container development.

Further precautions are taken to insure safety of the fluorine cylinders for shipment. They are stored for a period of a few weeks at a temperature of 130 deg. F. during which time the pressure of each cylinder is checked at intervals. This uncovers any leaky cylinders which might cause trouble and endanger personnel during subsequent handling. Quite possibly this is an excessive safety measure and may well be changed if future experience so dictates.

PROPERTIES AND REACTIONS

Fluorine is a nearly colorless gas about 30 percent heavier than air. Physically it resembles the fixed atmospheric gases, oxygen and nitrogen. The gas can be condensed below the critical temperature of —129 deg. C. to a liquid. Liquid fluorine boils at —187 deg. C. under 1 atm. pressure. Having a strong chlorine-like odor somewhat similar to that of ozone, it is highly irritating. Hazards of exposure are said to be similar to those of chlorine.

Reacting strongly with silicon-containing compounds, it can support continued combustion of glass and asbestos. Fluorine reacts vigorously with most metals at elevated temperatures and when ignited at red heat, steel burns readily. It readily displaces chlorine and other halogens from the solid metal halides such as salt, and reacts immediately with water to form hydrogen fluoride, oxygen, and some oxygen fluoride. One of the important reactions in the development of new products is the replacement of hydrogen in hydrocarbons by fluorine. This tends to produce compounds of greater stability than the original material.

NEW PRODUCTS

Availability of fluorine may be expected to intensify the research, in the field of fluorine compounds, that has been gaining steadily over the past few years. (see *Chem. & Met.* June 1944, pp. 101-3).

The part fluorine chemicals played in the war is exemplified by AHF used in aviation gasoline production, uranium hexafluoride used in separation of U235, and Freon, used as a refrigerant and as a propellant for "bug bombs."

Many new products, still in the development stage, show a good deal of promise. One of these is an organic fluoride liquid (a highly fluorinated hydrocarbon) non-flammable and non-toxic, with a high enough boiling point and specific gravity that it can replace mercury in the present mercury vapor boiler. Another is a gas, sulphur hexafluoride, already developed but requiring elemental fluorine to manufacture, said to be a more nearly perfect insulator than is presently available for high voltages used in X-ray and nuclear physics work.

Other developments include a highly stable synthetic lubricating oil, insecticides, anesthetics, solvents, fireproofing materials, resins and plastics.

Grateful acknowledgement is made to Dr. John F. Gall of the Pennsylvania Salt Manufacturing Co. for providing the technical information presented in this article.

EDITORIAL STAFF SUMMARY

TECHNICAL MANPOWER
Falls Short of Industry Requirements

Shortage of manpower for process industry is constantly more serious, both for engineers and scientists and for technicians and skilled operators. The outlook for the future is even more serious than the present situation. Little relief can be expected from the colleges and universities in the near future, as they are flooded with veterans clamoring for their "G. I. Rights." The whole matter is still further complicated by political factors, some of which seem to take on definitely partisan flavor as Washington political managers undertake to organize the universities as part of their machines. None of these problems is made any simpler by the bitter controversy over labor legislation and the extent to which the government is going to dictate policies.—*Editors*

MANPOWER problems of chemical process industry are becoming much more difficult of solution. The demand for skilled brain-power is growing. The supply of available persons is declining, both at the professional level and among technicians. Management is therefore confronted with many questions in organizing anew various phases of our industry on the assumption that fewer persons must do the work.

Mechanization of many operations and the conversion of intermittent to continuous process are two obvious remedies. Larger units which are much more nearly automatic in function are also to be expected. The result may be the requirement of persons of still higher skill; but that trend can be tolerated if the number of persons needed be smaller.

This *Chem. & Met.* report undertakes to explain the complexities of the problems as they deal with questions of manpower supply. Frankly, it does not undertake to give answers to many of the questions outlined. Nevertheless it is hoped that a frank statement may assist in meeting the disturbing trend even though the presentation here is largely a discouraging preview of more difficulties to come.

Distribution of employment of those engaged in chemical engineering and chemical fields is indicated, prewar and during the war, in Table I. The table is based on a similar compilation prepared by the Department of Labor's Bureau of Labor Statistics from data collected by the Bureau and the American Chemical Society and analyzed in the June, 1946, issue of the "Monthly Labor Review."

WHERE THEY WORK

Questionnaires returned by those in military service and those employed outside chemistry and chemical engineering were excluded from the compilation. Also, only those individauls who reported for both years were considered. The data cover principally the professional workers, but also include some individuals of lesser training. Routine workers in laboratory and plant as well as executives and technologists are involved in the figures. About 87 percent of those reporting in the surveys had at least a bachelor's degree, an additional 6 percent had no degree but had taken some college courses, and another 3 percent possessed degrees in other fields of science or engineering.

The 1943 distribution was not markedly different from what it was in 1941. However, during 1943 the federal governmental offices took a somewhat higher percentage, educational institutions dropped by a few percent, and employment in miscellaneous chemical industries rose by several points. Manufacturing is, of course, the largest source of demand for technologists and technicians and will remain so in the foreseeable future. It is interesting to note that in both years a much higher proportion of workers in chemical lines than in chemical engineering has been in public services, performing such tasks as inspection, analysis, research and administration.

Table I — Percentage Distribution, by Source of Employment, of Persons in Chemical Engineering and Chemistry[1]

	Chemical Engineering		Chemistry	
Source of Employment	1941	1943	1941	1943
Public authorities:				
Federal government	3.2	4.9	5.5	7.4
State, county and municipal	2.9	1.5	14.7	11.2
Other public	0.5	1.0	2.3	2.2
Subtotal, public authorities	6.6	7.4	22.5	20.8
Non-public:				
Educational institutions	2.4	1.5	9.3	6.9
Manufacturing:				
Food	3.6	3.2	5.2	5.2
Textiles	1.6	1.6	4.5	2.1
Paper and allied products	4.9	4.4	0.5	2.2
Paints, varnishes, colors	5.4	4.2	6.6	6.2
Miscellaneous chemical industries	30.9	32.3	10.4	22.6
Petroleum and coal products	17.2	17.1	7.5	7.7
Rubber products	4.1	4.5	3.2	3.8
Other manufacturing	14.3	15.6	11.7	14.1
Subtotal, manufacturing	82.0	82.9	58.6	64.0
Other private organizations[2]	4.7	4.3	4.5	3.4
Other non-public[3]	4.3	3.8	5.0	4.9
Subtotal, non-public	93.4	92.5	77.4	79.2
Retired, unemployed or direct relief	...	0.1	0.1	...
Total percentage	100.0	100.0	100.0	100.0

[1] Data from Bureau of Labor Statistics (U. S. Dept. of Labor) in cooperation with American Chemical Society. [2] Includes mining, construction, public utilities, etc. [3] Includes research institutions, consulting laboratories, associations, etc.

Within the manufacturing group the high proportion of technical employees engaged in the manufacture of petroleum and coal products is noteworthy. Petroleum refining is constantly pushing farther into the chemical realm not only because of more extensive chemical processing of raw materials but also because more petroleum chemicals are being produced. The industry may be expected to maintain a heavy demand for technologists and technicians. Table I shows no percentage-wise increase in this class of workers during 1943, but that is a reflection of the fact that in the petroleum refining industry only skilled workers who were directly engaged in the manufacture of

Table II—Comparison of Five Levels of Salaries of Persons Working in Chemical Engineering and Chemistry*

Salary Group	Median Base Monthly Income in Dollars			
	Chemical Engineering		Chemistry	
	1941	1943	1941	1943
90 percent earned more than	144	199	107	160
75	174	236	148	194
50	235	297	200	243
25	333	400	276	318
10	490	540	383	426

* Bureau of Labor Statistics (U. S. Dept. of Labor) in cooperation with American Chemical Society.

certain critically needed war products were deferrable under draft regulations.

Employers seeking recruits for office, plant and laboratory recognize the fact that chemists, engineers and technicians have enjoyed a higher income during the last few years, in common with most occupational groups and are likely to retain their gains. Scarcity of professionals is, of course, one factor. Another is the unionization of a large segment of men at the technician levels.

LEVELS OF EARNINGS

Table II affords a comparison of prewar with war incomes of five groups working in chemical engineering and chemical fields. The data are from a tabulation compiled by the Bureau of Labor Statistics from information collected by that agency and the American Chemical Society. The calculations are based on questionnaire returns from all persons who reported income either in 1941 or 1943. Because the survey omits the income in 1941 of persons who left the field since that year, including long-experienced men who died or retired with relatively high salaries, the 1941 averages may be somewhat lower than the actual averages for that year.

The effect of years of experience upon employees' value, and consequently their earnings, is seen in Table III, which presents data from the sources cited above. The annual income figures include salaries, fees and bonuses received, whether or not earned within the fields in question. The calculations cover not only the professionals but others working along chemical and chemical engineering lines, and exclude data from persons who were in military service in 1943.

Highest salaries were, as might be expected, earned in administrative positions. The relative distribution of such positions in chemical engineering and chemical branches is seen in Table IV. The table indicates that over one-fourth the engineers were engaged in technical administration, compared to only 15 percent in the chemical field. On the other hand, analysis and testing, a comparatively low-pay division, is seen to be of slight significance in engineering, but it occupies about 25 percent of the chemical workers.

Tremendous increase in registration and attempted registration at all levels of technical training has surprised even the most enthusiastic forecasters as to the response to be expected of veterans regarding training under the G.I. bill of rights. Responsible forecasts in Washington indicate that a quarter million young veterans are being turned away from colleges and universities because there simply is not another spot in which to house, teach or train them. The problem at the level of the technical institutes is almost as bad, though enlarged and new facilities for technician training can be much more quickly provided in such schools than for college grade and graduate work.

THE COLLEGE JAM

Technical training at college level is suffering even more than some of the other divisions of university work. There are two reasons for this. Larger numbers of veterans are eligible in business and cultural courses than are prepared to enter without qualification in chemistry, chemical engineering, and other engineering curricula. Universities are taking such applicants as generously as possible in view of limited housing, classroom, general laboratory, and other space available. Thus those seeking full technologic training are being pushed aside by the stampede of the other groups.

Faculties available for training scientists and engineers have been much more seriously reduced in numbers by diversion to wartime projects, a considerable number of which have not yet been completely eliminated from the programs of former professors and instructors. The number of chemical registrants at various college levels can not, therefore, be increased as rapidly as would be desirable in order to begin now rebuilding the ranks of trained engineers.

One of the most serious features of the college problem currently is the lack of adequate faculties. There are two major causes of this difficulty. A large number of professors have been in war work and have become acquainted with new projects which interest them permanently. The other problem comes, of course, from the deluge of students at all levels of college work. A faculty unimpaired from prewar standards is obviously no longer adequate when the student body has doubled, as at many colleges.

Table III—Annual Income, by Years of Experience in Chemical Engineering and Chemistry, 1943*

Years of Experience	Median Annual Income in Dollars	
	Chemical Engineering	Chemistry
1 (under)	2,452	2,152
1	2,802	2,514
2	3,017	2,659
3	3,156	2,754
4	3,291	2,786
5	3,472	3,003
6	3,616	3,116
7-9	3,913	3,262
10-12	4,414	3,454
13-15	4,799	3,604
16-20	5,838	3,980
21-25	5,788	4,597
26-30	6,620	4,439
31-35	.....	4,497
36-40	.....	4,751
41-43	.....	4,527

* Bureau of Labor Statistics (U. S. Dept. of Labor) in cooperation with American Chemical Society.

Table IV—Percentage Distribution, by Occupational Status, of Persons Engaged in Chemical Engineering and Chemistry, 1943*

	Chemical Engineering	Chemistry
Research, industrial	11.9	22.6
Administration, technical	27.2	14.9
Teaching, college or university	....	6.5
Analysis and testing	....	23.8
Research in basic science	....	4.8
Development	15.1	5.9
Production	21.7	7.7
Technical service	6.2	2.1
Teaching, secondary schools	....	5.7
Design	5.1	....
All other	12.8	6.0
	100.0	100.0

* Bureau of Labor Statistics (U. S. Dept. of Labor) in cooperation with American Chemical Society.

One of the most serious difficulties in rebuilding faculties is that of salary levels. In the past the attraction to industry because of higher compensation was considerable, but nothing like as great as now. And the deans of engineering are finding it difficult to adjust salaries in their departments to meet industrial competition. In many schools they would be able to do this within their budgets were it not for the fact that they can not raise the pay in chemical engineering without considering also comparable changes in English, history and other subjects. That, of course, means that the salary standard of the whole institution may require change, which does produce impossible strains on budgets for which income is smaller now than ever before because of low percentage return on endowments.

In the manpower report (*Chem. & Met.*, April 1945) a hope was expressed that specialized war training might provide a limited number of persons useful as junior profession workers. It is difficult to say how much that source of personnel has been helpful, but we now can appraise the magnitude of the training work done during the five fiscal years from Dec. 9, 1940, when instruction began, to the termination of the last courses which closed on June 30, 1945.

SPECIAL WAR TRAINEES

Every institution giving any college-grade of work in engineering participated in the special "Engineering, Science, and Management War Training" which was under the U. S. Office of Education. Table V shows the number of institutions, the number of

Table V—Summary of Engineering, Science, and Management War Training Programs From October 9, 1940, Through June 30, 1945

	EDT 1940–1941	ESMDT 1941–1942	ESMWT I 1942–1943	ESMWT II 1943–1944	ESMWT III 1944–1945	All Programs 1940–1945
Institutions participating in program	143	194	214	195	172	227
Courses operated in:						
All fields	2,182	7,595	12,740	11,547	8,501	42,568
Engineering	2,182	6,174	9,527	7,859	5,723	31,465
Chemistry	0	220	480	437	296	1,433
Physics	0	132	231	270	238	871
Production supervision	0	1,072	2,502	2,981	2,244	8,799
Enrollment in:						
All fields	120,802	438,503	596,134	402,684	237,593	1,795,716
Engineering	120,802	350,564	443,938	265,366	156,555	1,337,225
Chemistry	0	7,914	13,929	10,664	6,331	38,838
Physics	0	5,813	11,998	8,620	5,984	32,415
Production supervision	0	74,212	126,269	118,034	68,723	387,238
Full-time courses	18,607	22,021	47,305	14,379	3,942	106,254
Enrollment of:						
Females	811	38,341	130,245	79,612	33,226	282,235
Negroes	849	3,265	10,539	7,574	2,931	25,158
Armed forces	1,554	7,970	12,967	15,325	0	37,816
Veterans	0	0	0	6,094	8,221	14,315

courses of study, and the number and types of trainees who registered.

It is interesting to note that practically 1,800,000 registrations occurred in the course of this program, an evidence of the skill and speed with which engineering educators adapted their facilities to war needs. This suggests that possibly some comparable near-emergency program may have to be set up with the aggressive leadership of the educators supported by the adequate backing of practicing professional men in industry. Unless some such comparable effort to produce postwar trainees is arranged, the prospect for adequately trained men from the colleges is not bright.

GRADUATE STUDENT TRENDS

Certain deceptive factors have appeared in the field of graduate study for science and engineering. A considerable number of young men were within a few months or a year of completion of advanced degrees. These men are coming back, and many are being granted the doctorate degree this summer and early fall. Thus there is a false peak in numbers which has deceived some casual observers.

Also currently evident is a large registration of young men who seek a master's degree after release from the military services. Some of these men wisely conclude that a year's college work will afford them a splendid opportunity for complete readjustment to civilian life. And a great many others have seen in their military experience the great value of training in some specialty which they missed while at college. Both groups find it an advantage to go into graduate work for one year, since they can do so without direct outlay because of their veteran's privileges.

It does not seem likely that this sudden burst of registrations for graduate study is going to continue. But forecasts on that point are very difficult since many completing their bachelor's degree work under the G.I. bill of rights soon may want to get a master's degree also. Promising students are, of course, eligible for government aid in that graduate work provided the total schooling for which Uncle Sam pays is not over four years.

Those who have surveyed these problems nationally feel that there may be a substantial number of men with a master's and doctor's degree becoming available for industry during the latter half of 1946 and the calendar year 1947. But such men will not be duplicated year after year for some time to come. It is likely to take from three to five years before the normal flow of students from undergraduate to graduate work is again resumed. The decision regarding drafting young men in their teens may further affect this, especially if Congress should again get politically excited over this question in 1947.

ROSTER TRIES TO HELP

National Roster of Scientific and Specialized Personnel has continued during the fiscal year ended June 30, 1945, as a unit of U. S. Employment Service in the Department of Labor. Seeking to meet the needs of both individuals and employers, the Roster has undertaken to set up methods by which those seeking work and those seeking workers of a professional sort might be assisted in getting together.

When a professionally qualified individual seeks a new position he is invited to file with the Roster an "Application for Placement." In this he gives details of his background in training and experience, together with any indications either as to preference or limitation on type of employment which he is seeking. He is asked to indicate, among other facts, the minimum acceptable salary, acceptable locations, and types of employment which he would be willing to consider. As a supplement to such statement it is very desirable that the individual have on record with the Roster a complete personnel record, such as those which several hundred thousand persons filled out during the war period.

Willingness to take a new professional engagement can be indicated by those out of employment and by those merely seeking a more favorable position. The Roster is careful to safeguard as far as possible the confidential portions of a man's statement so that he will not be embarrassed with his present or previous employers. Any application is, within these limits, matched up as much as possible with inquiries for personnel which the Roster has received from employers.

EMPLOYERS USE ROSTER

Employers seeking professional personnel are invited to send a description of their needs to the National Roster. Such statement which may be in an informal letter should describe the duties and minimum qualifications required, together with some indication of salary range and other pertinent data as to the vacancy to be filled. Such a request is known at the Roster as an "order." The first step in handling such a request for filling a position is to review lists of persons who have indicated that they are seeking positions. If there is any apparent coordination between the individuals' applications and industry's orders the two are brought in touch with each other as directly and promptly as possible.

JOB CLASSIFICATION

One of the means used in getting a job or in getting professional employees must be a definition of classes of employment. To serve that purpose National Roster has prepared quite a number of documents which are available from the Supt. of Documents, U. S. Govt. Printing Office, Washington, D. C.

Table VI—Engineering Civilian Student Enrollment by Courses, Undergraduates and Graduates, U. S. and Canada

	1940-41[1]	1941-42[2]	1944-45[3]	Nov. 5, 1945
Mining	1,978	1,501	224	533
Metallurgy	2,480	2,712	472	1,214
Pet. & n. gas	2,877	2,143	376	1,083
Ceramics	843	746	190	249
Geology	792	.....	.....	.....
Fuel technology	44	.....	.....	.....
Special students	149	.....	.....	.....
Total mineral	9,133	7,102	1,262	3,079
Chemical	.....	17,778	5,082	7,766
Civil	.....	11,374	3,537	7,233
Mechanical	.....	28,564	6,965	13,553
Electrical	.....	15,348	5,034	12,082
Others	.....	35,062	18,852[5]	29,556
Total	114,116	115,228	41,632	73,269

[1] *Min. and Met.*, Sept. 1941, U. S. only. [2] *J. of Eng. Ed.*, Dec. 1941, U. S. and Canada. [3] *J. of Eng. Ed.*, Dec. 1944, U. S. and Canada. [4] *J. of Eng. Ed.*, Jan. 1946, U. S. and Canada, advance data. [5] Includes 3,163 graduate students, all branches.

MILES OF GLASS PIPING

Fabricated in Field At Oak Ridge

B. W. WHITEHURST
Engineer, Stone & Webster Engineering Corp., Boston, Mass.

Field fabrication was chosen for the more than 7½ miles of industrial glass piping installed in the electromagnetic separation plant at the Clinton Engineer Works. Large scale field fabrication of glass pipe had never before been undertaken and the methods were not at first well understood, requiring much development work. In this method, however, lay the only chance of completing the job on schedule.—*Editors*

Fig. 1—The hot wire method was used with great success in making more than 35,000 cuts in pipe

Boro-silicate glass piping, referred to under the trade name of Pyrex, has many advantages in the food processing industry and the manufacture of bio-chemicals, as well as general chemical processes. Among these advantages may be mentioned its resistance to most acids; also the transparency of the piping, which permits the operator to observe the processed material as it is being transported and to note its clarity and other physical characteristics.

The use of Pyrex piping for the conduction of chemical fluids is not new, but when Stone & Webster Engineering Corp. installed at the Clinton Engineer Works, Oak Ridge, Tenn., over 7½ miles of glass piping in sizes up to 4 in., a gigantic forward step in construction technique was achieved. To accomplish this, a shop was erected in the field completely equipped with bench model sealing jigs and electric glass cutting and sealing and stress relieving equipment for the fabrication of glass piping in a manner not unlike that of the cutting, welding and fabrication of steel pipe. This was the first time in engineering history that large scale field fabrication of glass piping was attempted and successfully completed.

Many novel techniques were developed and used by the construction forces, and methods heretofore considered as laboratory practices were converted overnight to standard field procedures. Some idea of the magnitude of their job may be realized when one considers that over 35,000 cuts were made in the glass piping; over 30,000 sections of glass piping were fused together necessitating the making of 15,000 welds. Over 3,000 special fittings were made, some of these exceedingly complex.

Prior to this time the orthodox method of equipping an installation with glass piping was to submit to the supplier an assembly drawing showing the location of each piece of equipment and the location of the connecting piping runs, and detailed drawings of the individual glass fittings if they were of a special nature. The supplier of the material prefabricated the glass piping and shipped it, packed in excelsior, to the site where it was unpacked, assembled and installed. Even though this method lacks flexibility, prior to the war it was considered by engineers to be satisfactory. Examples of its limitations are:

1. Where the location of heavy equipment is changed to conform to revisions of flow diagrams.

2. When the design or location of the equipment outlets are not crystallized.

These and similar conditions require revision of drawings and further negotiations with the supplier. Such actions upset the manufacturing production schedules, causing delays in deliveries, thereby endangering prescribed completion dates.

Under impetus of the exceedingly close time schedules prescribed by the War Department, and the desire of the Stone & Webster Engineering Corp. to meet their completion dates, it was reasoned that the solution to the problem lay in the cutting, welding and fabricating of the glass piping in the field.

Corning Glass Works cooperated fully in this undertaking by leasing to Stone & Webster several sets of glass welding equipment; also, they assigned one of their engineers, versed in the glass techniques used at the Corning Glass Works, Corning, N. Y., for the purpose of imparting to two selected pipefitters the knowledge of glass manipulation. Much credit goes to these pioneers for the painstaking manner in which they applied themselves.

One of the major problems that faced Stone & Webster was that of obtaining proficient glass workers. Pipefitters who had been accustomed to the handling of steel piping were trained to fabricate glass piping. It was recognized that these men were embarking on a new type of work requiring techniques acquired only through experience and application to detail. By the time the fabrication of glass piping and fittings had reached its peak, about 25 pipefitters had become skilled glass artisans.

Boro-silicate glass piping in the hands of skilled glass workers offers the same flexibility in bending to special shapes and in the fabrication of manifolds as does metal

pipe, except that the sealing, bending and flanging require specialized methods of production. In general these techniques closely follow those of soda glass manipulations except that higher temperatures are required for bending and sealing. A gas flame alone, even at temperatures of the oxygen-hydrogen torch, does not supply sufficient heat to make a satisfactory seal except for thin-wall tubing. Great care must also be exercised in the annealing of freshly made seals to remove adequately the stresses incurred during the heating and fusing of the pipe sections and the subsequent cooling of the heated areas.

Installation of glass pipe demands close attention to support and hanger details, to the correct axial aligning of the piping and the parallel alignment of the flange faces before taking up the bolts. The insertion into the pipeline of expansion or slip joints, or the use of loops to compensate for thermal expansion, must be considered. Where the piping is run along walls and columns, adequate protection should be provided against damage by collision. Likewise, protection from falling objects must be afforded and the placing of ladders and other construction equipment against the installed pipe avoided.

Fig. 3—Electric resistance furnaces were used to anneal the joints in glass piping after welding to prevent strains and breaks at the joint

CUTTING GLASS

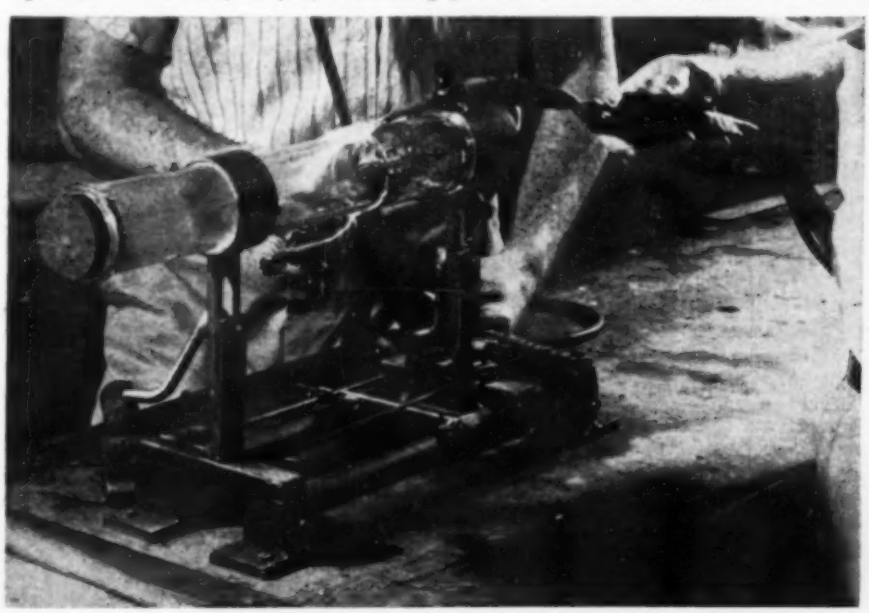
The cutting of glass piping is one of the earliest arts perfected in glass manufacture. Soft soda glass was scored peripherally with a sharp-edged flint or a file, and the glass broken apart by smartly tapping the glass or touching the score with a hot metal rod.

Of the several methods available today for the severing of glass tubing and piping, the use of a hot wire loop applied peripherally to the glass piping was selected as being the most speedy and satisfactory. This method, while one of the oldest, is still a favorite.

This procedure comprises deeply scratching a score mark about ¼ to 1½ in. long, depending upon the circumference of the pipe, at the point where the pipe is to be separated. A Nichrome wire loop is then adjusted around the glass tubing at the score mark, and electric current controlled by a Variac transformer is applied to the wire (see Fig. 1). A foot switch is used to turn the heater current on and off. The wire, after being properly located, is held taut, heated to a dull red and held at this temperature for approximately 1 minute. At the end of the heating period, the current is turned off. When all color fades from the wire it is removed and a damp cloth applied, first to the score mark and then slowly wiped around the heated circumference of the pipe. The resulting strains usually cause the pipe to break clean. Sometimes towards the end of the heating period a crack may start at the file scratch and travel completely around the pipe and the pipe break asunder. Should the initial crack not extend through the pipe wall, or not completely encircle the pipe, a smart rap is all that is required to effect the separation.

Certain precautions are necessary for the successful severence of the pipe. For example, it is essential that the hot wire make a uniform contact with the surface of the pipe. This is readily accomplished by forcing the hot wire to the glass surface by means of a carbon paddle. The pipe should be well supported, preferably in wooden V-blocks, during the cutting operation. Accuracy in cutting the pipe edges squarely with the pipes axis is important. The squareness of the cut may be readily checked by standing the flanged end on a flat surface and measuring the pipe as it is rotated.

Fig. 2—High speed sealing of joints in thick walled tubing could be accomplished satisfactorily only by combining gas flames and high frequency current



PIPE WELDING

One of the greatest advances in early science was the discovery that glass changes from a solid to a viscous state and while in this viscous state could be worked into various sizes and shapes. But it was not until glass tubing became an article of commerce that means of uniting sections of tubing into one continuous piece, and the art of sealing (welding), assumed economic importance.

Sealing of Pyrex glass tubing in moderate

wall thickness is relatively simple and is part of the knowledge of every chemist and physicist. For such work the heat of any oxy-hydrogen gas flame is adequate. In sealing thick-wall tubing of large sizes, however, flame heating produces unsatisfactory results causing outer surfaces to become overheated while the inner surfaces may not attain a high enough temperature to insure a satisfactory seal.

It has been recognized that when glass is sufficiently heated it becomes electrically conductive. If high frequency currents of sufficient magnitude are caused to flow through the pipe it will become uniformly heated throughout the wall's cross section and becomes sufficiently plastic to permit satisfactory sealing. The preheating flame is applied by two standard oxy-hydrogen torches modified by attaching to the tip of each torch a lead from a high frequency oscillator. The current is conducted to the glass by the active ions in the flame.

The one significant thing about this sealing process is the use of high frequency currents for heating the glass. It has been pointed out that the flame method fails because sufficient heat cannot penetrate the glass wall; whereas, when the high frequency currents are superimposed on the gas flame the entire cross section of the piping will become highly and uniformly heated.

The procedure of sealing is briefly this: The two sections of pipe it is desired to weld together are mounted in a jig designed to align the sections axially, their edges being square with the pipe's axis. The ends are then separated about ½ in. and preheated with an oxy-hydrogen flame until hot enough to become electrically conductive. As the two adjacent ends of the pipe are then brought into intimate contact with each other and the heat continued, the high frequency current is caused to flow through the flame and the heated section of the glass until the seal is fused, as in Fig. 2. The seal is shaped by blowing a slight pressure into the pipe, thus stretching it slightly, and wiping the seal with a carbon paddle of sufficient width to bear upon the relatively cold part of the glass. The seal is then permitted to cool slightly before the piece is removed from the jig and placed in an electric annealing furnace.

REMOVING THE STRESSES

One of the most significant advances in glass technology was the discovery that its brittleness could in part be overcome by heating the glass to a temperature close to its vicous point and then permitting it to cool without subjecting it to drafts until it had reached a temperature approximately that of the ambient air. It is believed by archeologists that annealing of glass was first discovered around 1500 B. C. and was kept a guarded secret by the Phoenicians and Egyptians. The stress relieving of glass today is of extreme economic importance

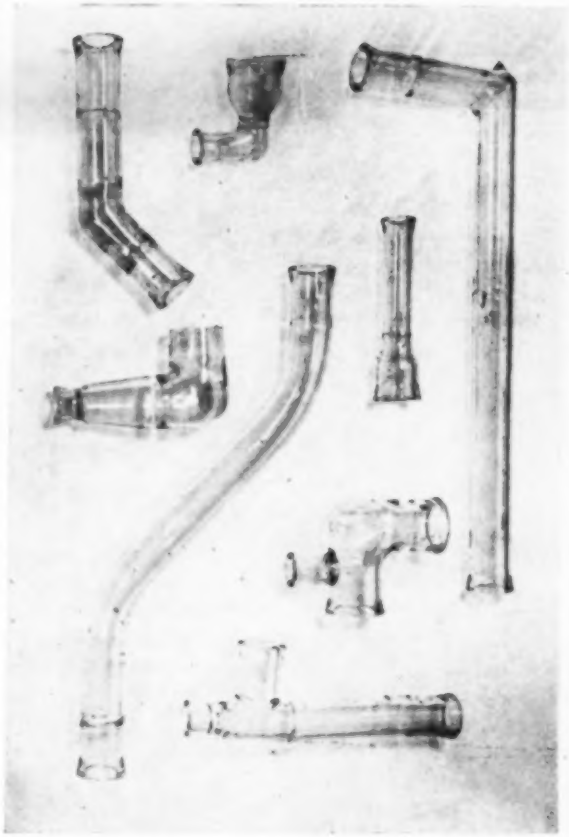


Fig. 4—More than 3,000 special piping details such as these were used

Fig. 5—Fabrication of this complex manifold required over 70 steps

and this is particularly true in the installation of long lengths of glass piping which may be subject to stresses resulting from changes of temperature or installation strains.

In most cases the stress relieving or annealing of a piece of glass pipe or a fitting is a simple procedure. Nevertheless it requires close attention to details. During the process of sealing boro-silicate pipe, severe stresses are incurred and, should the pipe after sealing be allowed to cool to room temperature, it may soon break apart at the point of seal. In order to prevent such breaks within the piping system, stress relieving is imperative. This annealing is accomplished by heating the seal and the adjacent areas 2 in. or more beyond each side of the seal in an electric type of oven, as in Fig. 3, for a period of 6 to 12 minutes. Afterwards, the heat is turned off and the pipe permitted to cool within the annealer to approximately room temperature, with frequent rotation of the piece during annealing.

Precautions to be taken are that the heating must be uniform and that the piece being annealed must not be subjected to drafts or sudden changes in temperature.

To the unaided eye, a piece of unannealed and highly strained glass pipe appears no different from a piece that is well annealed and strain free. When a piece of annealed glass is viewed through a polariscope, there is little evidence of color. However, when a piece of unannealed pipe is viewed through a polariscope, there appear brightly colored bands indicative of strain. These color bands result from the fact that the glass, when under strain, becomes doubly refractive. Plain polarized light passing through a region of strain separates into two rays, polarized respectively parallel and perpendicular to the direction of stress. These rays in passing through the glass at different velocities emerge with a phase difference proportional to the stress and thickness of the glass. Severely strained pieces may show successive rainbows of color. The frequency and intensity of these colors enable the operator to judge the severity of the strain and the progress of annealing as well as the necessary annealing time.

In general, thick-wall piping shows more color under stress and, by the same token, more color may be permitted in the annealed piece than would be the case with thin-wall pipe. A temperature around 500 deg. C. is required for the annealing of thick-walled pipe and the rate at which it is cooled should not exceed 25 to 35 deg. C. per minute. This implies that for glass pipe 2 in. in diameter and ½ in. thick the cooling period should be in the neighborhood of 15 minutes.

In the hands of skilled artisans there is no apparent limit to the complexity of special piping details that may be fabricated. It is estimated that over 3,000 special

piping details such as eccentric and concentric reducers, crosses, side outlet tees, offset bends and complex manifolds were used in the fabrication of the piping runs at the Clinton Engineer Works. A few of these appear in Fig. 4.

SPECIAL FITTINGS

In fabricating the manifold shown in Fig. 5, over 70 major sequential steps were required. These comprised 35 cuttings to reduce the sections to size or to square the ends. Then, 18 separate welds were necessary to assemble the sections into a completed unit. After each section was welded on to the preceding united sections it was necessary to remove the assembly from the sealing jig and anneal the freshly made weld before proceeding with further fabrication. The accuracy attained between the outlets of special fittings approximates that of metal fabrication.

The manufacture of these special details by the field forces repeatedly saved many days and sometimes weeks of delay. Promises of delivery for special fittings would, in many instances, be from one to two months from the factory and this time should be compared with one to three hours required for the field fabrication of the simpler types of special fittings, to perhaps one man-day for the more complicated types.

The success or failure of a glass piping installation depends to a great extent on the manner in which it is installed. Care in the selection of the proper type of hanger is important. Equally important is the axial aligning of the pipe flange with the equipment outlet and the careful tightening of the flange bolts. A procedure was developed which resulted in a new solution of some of the commonly encountered construction difficulties. For example, in one case a piece of flanged equipment was removed to a new location and when relocated the outlet flange was 2 in. or more out of axial alignment with the connecting tee some 5 ft. away. Also, the flanges of the tee and the equipment outlet were 8 deg. out of parallel. This piece of equipment protruded through the floor above, with the equipment outlet near the ceiling, making accurate measurements difficult to obtain.

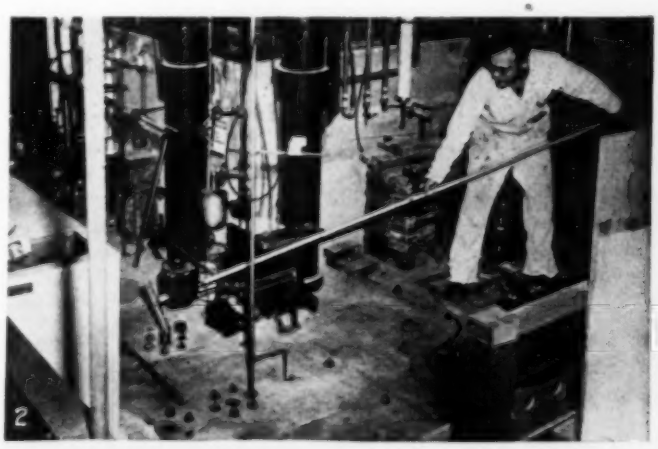
Freedom from strain in the connecting piping was imperative, and this was difficult to attain after the bolts were tightened in the make-up flanges. After two attempts to fabricate a satisfactory offset piece of the exact length and with the flanges in correct alignment it was decided to try to bend and anneal the connecting piping in place. This novel procedure was accomplished by procuring a piece of flanged pipe slightly shorter than the distance between the flanges of the equipment and the tee and securing this pipe rigidly to the outlet fitting of the stationary equipment. The other end of this pipe was supported by means of a rope hanging from the ceiling. Two small electric annealing furnaces were suspended in place in such a manner that the heating surfaces were concentric with the pipe to be bent.

After connections were made the glass was heated until it showed signs of softening. At this point the pipe was pushed in the direction of the tee outlet until the flanges were aligned axially. The ring closures were put into place, the gasket inserted, and the bolts drawn up slowly. This stretched the piping until the flange faces were in intimate contact. When this was accomplished the electric current to the furnaces was turned off and the pipe allowed to cool with the annealing furnaces still suspended from the ceiling and surrounding the pipe, in order to keep the cooling pipe free of drafts. After the annealing furnaces were removed the connecting piece was carefully examined with a portable polariscope and found free from strains.

It is evident that on large scale installations many operations heretofore confined exclusively to the shops of the supplier may be profitably transferred to the field, and that field welding and fabrication of Pyrex pipe may be considered an acceptable engineering procedure.

Making Isotopes at Oak Ridge

Last month our news pages announced plans developed by Manhattan Engineer District for distribution of radioactive isotopes for research. The pictures reproduced here give some idea of the extreme precautions used at Oak Ridge in producing these dangerous materials. Fig. 1 shows the removal of radioactivated material from the shut-down pile, using a lead shield and constant check on strength of radiation. Fig. 2 shows active material being introduced through the roof of a concrete cubicle where remote controlled extraction of pure isotopes takes place. Fig. 3, the side wall of the cubicle, shows the remote controls and observation devices.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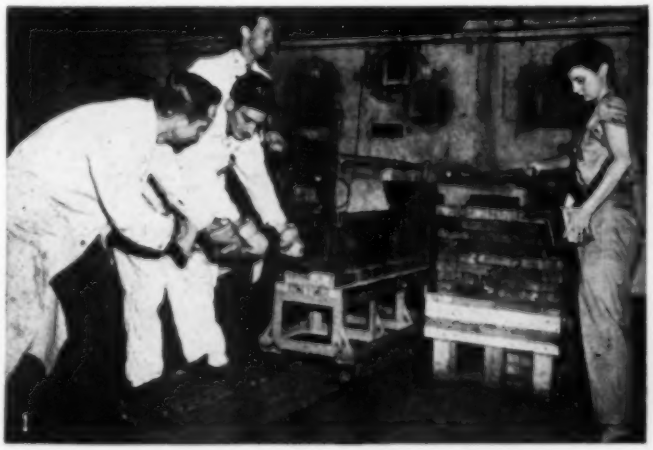
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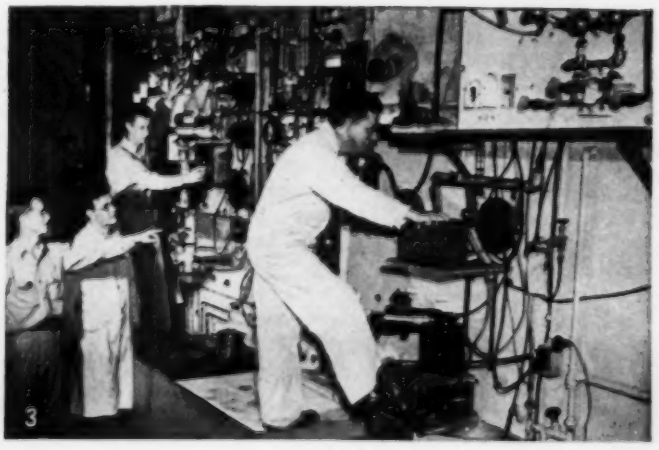
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C. L. NORTON, Jr. *Technical Director, Refractories Div., The Babcock & Wilcox Co., New York, N. Y.*

PEBBLE HEATER

New Heat Transfer Unit for Industry

Many applications for the pebble heater are found in chemical process industries

Developed during the war, the new pebble heater should find many uses in industry. Characterized by high thermal efficiency and low initial cost, this unit overcomes the temperature limitations of other commonly used heat transfer units. The pebble heater employs a continuously moving bed of refractory pellets which are first heated by high temperature gases (combustion products) and which then give up their heat to a cold gas passing through the bed. Details of construction, operation, and applications are described.—*Editors*

DURING the early part of the war, there was a need for a unit capable of heating steam to higher temperatures than could be obtained in metallic heaters, that could operate at moderate pressures, and that would maintain a uniform nonfluctuating temperature of the heated steam. As a result of these requirements, the pebble heater was developed.

The pebble heater overcomes some of the basic limitations inherent in the commonly used heat transfer units. Metallic tubular heaters are limited by the temperature-pressure limitation of the metals used in their construction. Tubular exchangers, in which a highly conductive refractory material is substituted for metal, overcome the temperature limitation of metal heaters. Here, one disadvantage is the difficulty of maintaining a tight seal between the refractory tubes and the tube sheet when operated at moderate or high pressures. The regenerative type heater has the disadvantage of bulky construction, fluctuating outlet temperatures, and reversing valves operating at high temperature. (For a detailed discussion of heat transmission see the report on Production, Application and Transfer of Heat, *Chem. & Met.*, May 1944, pp. 97-128.)

This article is taken from a paper presented by the author at the 48th annual meeting of the American Ceramic Society, Buffalo, N. Y., April 30, 1946.

EQUIPMENT DESCRIPTION

Fig. 1 shows a diagram of the pebble heater. It consists essentially of two cylindrical chambers *A* and *C* connected by the throat section *B* of reduced diameter. In operation, sections *A*, *B*, and *C* are filled with spherical refractory pellets. It can be seen that by filling the working chambers with spherical pellets, a permeable bed is formed through which gases can be made to travel. At the outlet of the bottom chamber *C*, there is a mechanical feeder *D* which controls the rate at which the refractory pellets flow through the system. After passing through the feeder, the pebbles are conveyed continuously by means of elevator *E* back to the top of chamber *A*. The pellets in the heater move downward at a constant rate during the entire operation.

Fuel and air are introduced at points *F*, and the products of combustion flow through hot gas inlets and then upward through the bed of downwardly moving pellets and out to the stack at point *G*. The pellets are heated by the combustion products and pass through the throat section *B* to the lower chamber *C*. At a point near the bottom of chamber *C*, the gas to be heated is introduced, as at point *H* in an annular chamber. The gases pass through a screen to provide uniform distribution and then travel upward through the heated pellet bed, and leave at point *J*, having been raised to the required temperature.

The surface area per cubic foot of pebble bed is very large in comparison to either a regenerative checker chamber or a tubular heater. A comparison of the relative surface area per cubic foot of pebbles, air heater tubes and standard checker spacing shows that the pebble heater can be made much more compact than the other types. The heat transfer surface per cubic foot of volume for $\frac{3}{8}$-in. diameter pebbles is 135.5 sq.ft., for $\frac{1}{2}$-in. diameter pebbles is 86.5 sq.ft., for $2\frac{1}{2}$-in. O. D. steel tubes $3\frac{1}{4}$x$3\frac{1}{4}$-in. on centers is 9.0 sq.ft., and for regenerator checker brick is 3.0 to 8.0 sq.ft.

HIGH EFFICIENCY

Thermal efficiency of such a unit will be high, since if sufficient pebble surface is supplied by selecting the proper length of chambers *A* and *C*, the pebbles leaving chamber *C* will approach the temperature of the entering gas at *H*, and likewise the temperature of the products of combustion leaving the

upper bed will approach the temperature of the pebbles returned to the top of the upper chamber **A**.

The reduced throat section *B* acts to increase the resistance to flow of gases between the two working chambers. In operation, the pressures in the two chambers are usually maintained at the same value so that there is no flow through the throat section. If a slight pressure differential should result, however, the high resistance of the throat section would allow only a small flow of gas through it, which may be important or unimportant depending on the nature of the gas being heated. Zero flow or a flow in either direction is maintained by automatic control of a damper in the exit stack of the upper chamber in response to variations in the pressure differential between the points *L* and *M* from a predetermined value.

The temperature to which gases can be heated is limited only by the limitations of the refractories used and the combustion temperatures obtainable.

One item of importance in some chemical fields is the speed with which gases can be heated. In the pebble heater, the surface area of the pebbles is so large that heating to high temperatures is possible in short periods of time.

CONSTRUCTION MATERIALS

Fig. 2(a) shows arrangement of a pebble heater for heating air from room temperature to 2,300 deg. F. The refractory pebbles used are of mullite composition (72 percent Al_2O_3, 28 percent SiO_2) and are ½-in. diameter spheres. In this arrangement, the refractories in the combustion chamber are kaolin brick for the outer walls and crown. The outer sidewalls are backed up with insulating firebrick, and the crown is insulated with light-weight castable. The throat section is composed of a kaolin-base tile. The port blocks connecting the combustion chamber with the upper chamber are made of a mullite composition to withstand the hot load conditions. All refractories used in contact with the moving pebbles are hard textured to prevent abrasion of the walls.

Fig. 2(b) is a section taken through the combustion chamber, showing the arrangement of burners and hot gas inlet ports. Fig. 2(c) is the rotary table feeder which controls the rate at which the pellets flow through the heater. It is located between the bottom chamber outlet and the elevator.

Table I—Typical Pebble Heater Operating Data

Gas being heated	Unit No. 1 Air	Unit No. 2 Steam
Exit gas temperature, deg. F.	2,180	1,800
Inlet gas temperature, deg. F.	100	230
Weight gas heated, lb. per hr.	1,800	4,400
B.t.u. per hr. in fuel	1,760,000	5,550,000
Weight of flue gas, lb. per hr.	2,240	8,000
Pebble circulation, lb. per hr.	2,150 (computed)	9,500
Flue gas exit temperature	750	805
Diameter lower bed, in.	19	27

The whole unit is surrounded by a gas-tight cylindrical steel casing which forms a rigid support for the brickwork. Table I shows typical performance data for pebble heater operation.

REFRACTORY PEBBLES

One of the most important refractory materials used in the construction of this heater are the refractory pebbles. The pebbles are the heat transfer medium and are kept in motion constantly during the operation of the unit. An average cycle is 30-50 min., so that from 29-48 complete cycles are made per day. The pebbles must be hard enough to withstand abrasion, have a structure which will withstand repeated heating and cooling, and be resistant to impact. Furthermore, they must be sufficiently refractory so that no softening or incipient

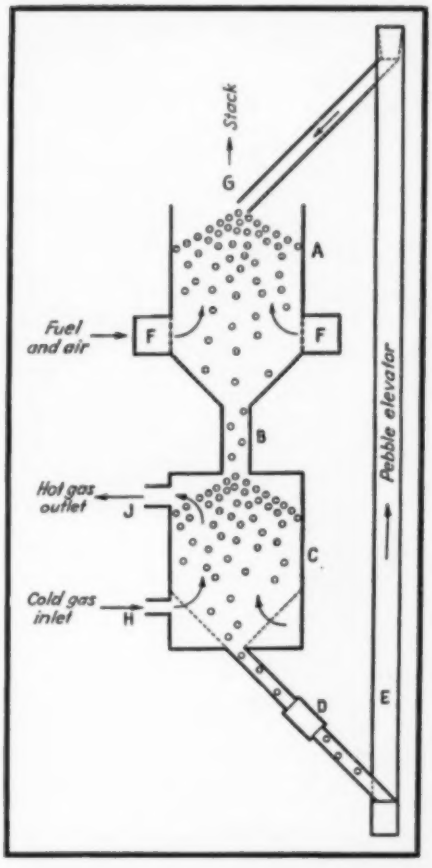


Fig. 1, Right—Schematic diagram showing the basic mechanism of the heater

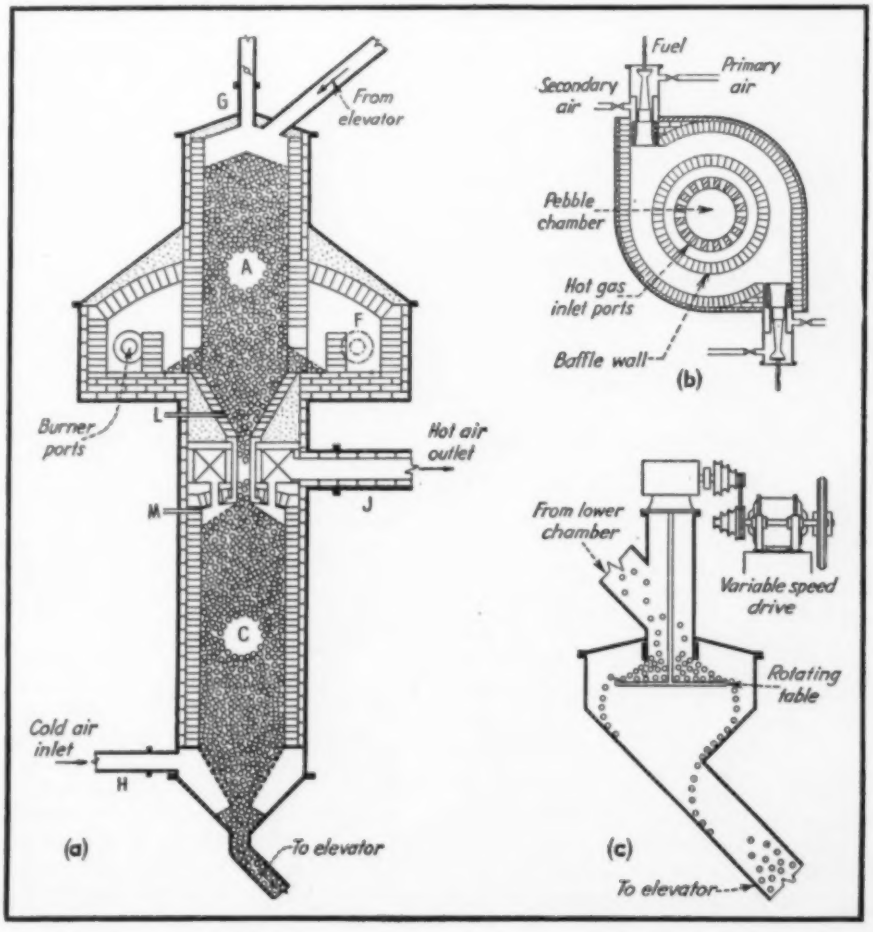
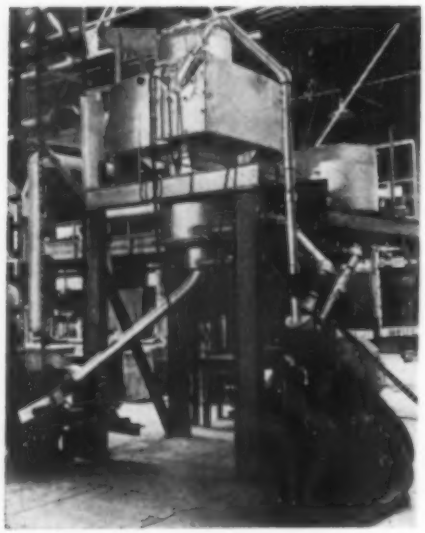


Fig. 2, Below—(a) Construction details of a pebble heater for heating air to 2,300 deg. F., (b) section through combustion chamber showing arrangement of burners and inlet ports, (c) feeder which regulates the flow of pellets



Pebble heater used in preheating air for high temperature combustion

fusion at any point in the upper bed will cause them to cluster together and cause "bridging" and stoppage of the moving bed. In spite of these requirements pebbles of several types have been in use for heating air for as long as three months continuous service with a pebble makeup of less than 0.25 percent per day, and with no outages due to pebble stoppage.

The pebbles which have been used are of three main types; kaolin, mullite, and an 85 percent Al_2O_3 composition. The pebbles are made by extruding the mix in a plastic condition, forming into spheres, drying, and firing. All three compositions are handled in approximately the same way.

Several methods of firing these pebbles were tried out, including rotary kiln firing, tunnel kiln firing and a special type of shaft kiln. The shaft kiln shown in Fig. 3 proved to be most efficient by a considerable margin and was adopted for use in manufacturing the pebbles.

FIRING THE PEBBLES

This kiln, unique in several respects, is worth further consideration. Air for combustion is introduced at the bottom of the shaft at point *A*, and passes up through at the bottom section of the shaft to point *B*, where it divides and goes to the combustion areas *C*, *C*, at which point fuel gas is introduced. Venturi sections *D*, *D*, cause intimate mixing of the combustion constituents, which results in complete combustion. The majority of the combustion air passes through the combustion channels and after mixing with the fuel enters the upper section of the shaft at points *E*, *E*.

Since the central portion of the shaft is full of pebbles the resistance to flow is much less in the open channels. Tests show that more than 85 percent of the air passes through the combustion channels. Since the flow of air through this central shaft between *B* and *E*, *E* is small, the cooling effect on the pebbles is in turn small, so that a holding or "soaking" zone is formed in this area. By choosing the proper length of combustion channel, any time of holding can be selected.

Thermal advantages of such a kiln are many. Due to the large surface area of the pebbles per cu.ft., the temperature difference between cold air entering the bottom of the shaft and the fired pebbles discharged at that point is small. Likewise the temperature of the flue gases leaving the top of the shaft can approach the temperature of the green pebbles being fed at the top. This means that the heat left in the discharged pebbles and the heat in the exit flue gas is a small percentage of the heat required to raise the pebbles to their burning temperature.

KILN EFFICIENCY

Most of us are accustomed to think of furnace efficiencies as stated by the relation:

$$\text{Percent efficiency} = \frac{\text{Heat input to the ware}}{\text{Heat supplied by fuel}}$$

This is a useful relationship to use in comparing the relative economy of different furnace constructions, but it is not a definition of true thermal efficiency. For example, we have recorded the fuel consumption of a tunnel kiln burning firebrick at 3,000 deg. F. as being 3,990 B.t.u. per pound of brick, which is equivalent to 20.1 percent efficiency according to the above definition. In the shaft kiln the fuel consumption per lb. of pebbles burned at 3,000 deg. F. is only 1,010 B.t.u. per lb. which corresponds to 78 percent efficiency. On short runs fuel consumption as low as 760 B.t.u. per lb. has been recorded which is equivalent to 105 percent, and indicates that the definition for furnace efficiency as shown by the above equation needs revision.

Temperatures obtainable in a shaft kiln of this type are governed mainly by refractory limitations and the lowering of theoretical combustion temperatures due to radiation and dissociation of the combustion products. Assuming low radiation losses, nearly all the heat in the fired pebble is transferred to the combustion air, so that a very large part of the B.t.u. value of the fuel is confined in the furnace and causes the temperature at the combustion zone to rise until the total losses from the furnace equal the heat input. When the total losses from the furnace are held to a minimum, the maximum combustion temperatures can be obtained.

HEATER OPERATION

There are a few basic relations affecting the operation of the pebble heater which should be covered briefly. The pebble heater is a counter-flow heat transfer apparatus in which $Q = UA\Delta t_m$ where Q = amount of heat transferred in B.t.u. per hr.; U = transfer coefficient, B.t.u. per hr. per sq.ft. per deg. F.; A = surface area of transfer medium, sq.ft.; and Δt_m = mean temperature difference, deg. F. between the hot and cold substances.

Surface area A of the pebbles can be computed for any diameter pebble, since the percentage pore space in the bed is substantially constant for different diameters. The surface area for $\frac{1}{16}$-in. diameter pebbles is 135.5 sq.ft. per cu.ft. of pebble bed, and for $\frac{1}{2}$-in. pebbles, the surface area is 86.5 sq.ft. per cu.ft.

A limiting factor which governs the capacity of the heater is the gas velocity through the bed which will cause pebble lifting or stoppage. For a specified rate of gas flow, a cross sectional area of the pebble bed is selected to give the proper gas velocity. This is done for both the upper and lower beds.

Table II shows the maximum allowable flow of various gases with different sizes of pebbles when the gas is being heated to 1,900 deg. F. These values are given in terms of the amount of gas flowing through each square foot of area normal to the direction of flow. Factor U in the relation $Q = UA\Delta t_m$ has been determined experimentally and for a unit heating gases from 100 to 1,900 deg. F., the values for U are given in Table III based on the flow rates shown in Table II.

Another factor which is required for design purposes is the pressure drop per foot

Fig. 3—Kiln for firing pebbles

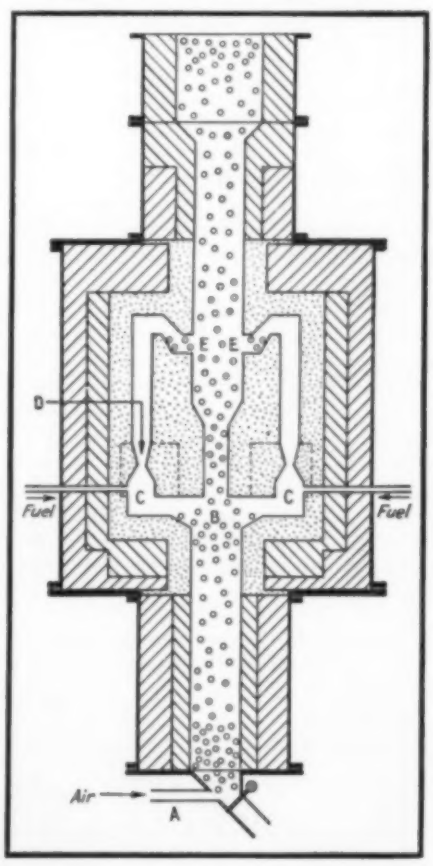


Table II—Maximum Gas Flow Through Pebble Bed

Gas Being Heated to 1,900 Deg. F.	Lb. per Hr. per Sq. Ft. of Bed	
	¼-In. Dia. Pebbles	½-In. Dia. Pebbles
Air	938	1,180
Steam	740	933
Methane	698	880
Hydrogen	248	312

Table III—Values of *U* for Different Gases

Gas Being Heated to 1,900 Deg. F.	B.t.u. per Hr. per Sq. Ft. per Deg. F.	
	¼-In. Dia. Pebbles	½ In. Dia. Pebbles
Air	4.3	4.5
Steam	5.0	5.3
Methane	8.2	8.7
Hydrogen	20.	22.

Table IV—Pressure Drop (Δ P) per Ft. of Bed Length

Gas Being Heated to 1,900 Deg. F.	In. H_2O per Ft. of Bed Length	
	¼ In. Dia. Pebbles	½ In. Dia. Pebbles
Air	7.7	6.9
Steam	7.7	6.9
Methane	7.7	6.9
Hydrogen	10.5	8.0

of bed length, so that the required inlet gas pressures can be determined. Assuming gas flows are those shown in Table II the pressure drop per foot of bed height would be as shown in Table IV.

The exact length of bed can be computed for any specified set of conditions, but to visualize the size of these heaters, a usual bed length will be between 3 to 5 ft. An average temperature difference between the pebbles and the gas will be 200 deg. F. for the usual operating condition.

For purposes of computation, the specific heat of the pebbles varies from 0.25 to 0.30 depending on the composition and the temperature range used.

Actual operation of these pebble heaters is not complicated. After the desired output conditions are established, changes are very slow and gradual and require only infrequent adjustment.

APPLICATIONS

The first application of this pebble heater has been for preheating air for combustion. By using highly preheated air, temperatures can be reached which have been generally considered as belonging to the field of electric arc furnaces. Fig. 4 shows the theoretical flame temperatures obtainable by the combustion of oil and air at different amounts of preheat. These figures are corrected for the lowering of flame temperature due to dissociation of combustion products, and are the results of computations. Fig. 5 shows a curve of recorded temperatures obtained in an oil-fired refractory furnace when using combustion air preheated to several different temperatures. It can be seen from this curve that temperatures approaching the melting point of Al_2O_3 (3,722 deg. F.) can be obtained by using combustion air at only 1,800 deg. F. The upper portion of this curve is dotted to indicate that equilibrium had not been established. The furnace was shut down on a rising gradient to avoid failure of the Al_2O_3 furnace roof.

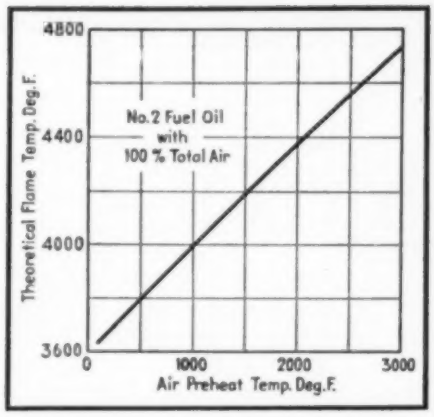


Fig. 4—Theoretical flame temperatures obtainable by combustion of oil and air at various temperatures

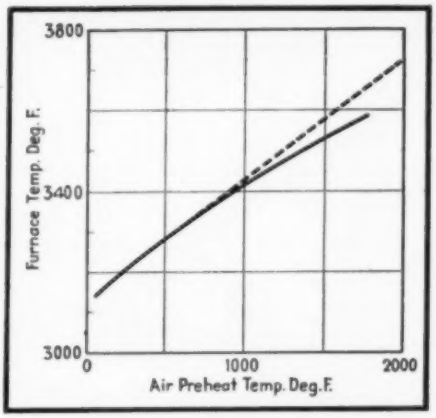


Fig. 5—Temperatures obtained in an oil fired refractory furnace using air heated to different temperatures

PROCESS STEAM

Another application of the pebble heater is the heating of steam for process operations. On pilot operations, steam has been heated with a steady non-fluctuating temperature of 1,800 deg. F. The use of such high temperature steam has been studied for chemical operations where quick heating followed by a rapid cooling is desired.

It may also be used to heat reducing gases such as hydrogen or natural gas for the reduction of metallic oxides. A small pilot unit has been constructed and preliminary runs heating hydrogen have been made.

In the field of refractories, there are many possibilities for the utilization of high combustion temperature. One of these is a continuous melting process for the production of prefused grog used in making high-grog brick and mortars. Hot load resistance and volume stability are increased when this prefused grog is used.

Fused cast refractories have also been made from materials melted in a high temperature combustion furnace. In this type of operation it is possible to duplicate electric furnace atmosphere by introducing small quantities of carbon or, where desirable, a carbon free oxidizing or neutral atmosphere can be maintained.

Another interesting development in connection with the melting of refractories, is the production of refractory mineral fibers formed by blowing a molten refractory stream by high pressure air or steam. Fibers have been produced which have a use limit much higher than rock wool or glass fibers. Refractory fibers can be made in this way which are very low in alkali content which in turn makes them adaptable for use in some chemically corrosive applications.

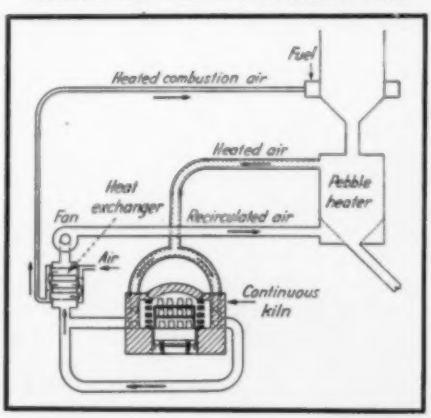
One other proposed use for the pebble heater is in the direct firing of ceramic ware. By introducing clean heated air into a ceramic kiln, no saggers or muffles will be required, and the design of the kiln can be made more compact and efficient. The absence of any reducing constituents in contact with the ware should give a condition comparable to that found in an electrically fired kiln. Fig. 6 shows a diagram of a pebble heater for firing a continuously operated ceramic kiln.

Although no cost comparisons under identical conditions are available between combustion and electric furnace melting, it will be obvious that the low initial cost, the high efficiency, and the use of low-cost gas or oil fuel make the pebble heater a desirable means of obtaining high temperatures.

ACKNOWLEDGEMENT

The developments described in this paper include the technical contributions of a number of executives and engineers of The Babcock & Wilcox Co., and in presenting this paper the author is acting primarily as the representative of this group.

Fig. 6—Pebble heater for firing ceramic ware in a continuous kiln



C. C. MONRAD *Carnegie Institute of Technology, Pittsburgh, Pa.*

SIGNIFICANCE
Of German Acetylene Developments

Among the most striking wartime achievements of the German chemical industry were their advances in the use of acetylene. Some of these developments in organic technology will be of interest and use in American chemical process industries.—*Editors*

MANY technical investigators studying German wartime industrial accomplishments have been particularly impressed with the progress made in the manufacture, purification and use of acetylene. Much of the German acetylene technology will be of use to American chemical manufacturers, although many of the developments will not fit into our economic picture.

Germany was faced with a shortage of petroleum, natural gas and agricultural products, and was required to base its organic industry largely on coal. Thus many materials which American industry obtains cheaply from petroleum had to be made in Germany starting from coal distillation, coal gasification or acetylene. As an example, almost all of the chemicals based on ethylene were produced indirectly from coal since the ethylene used was obtained by hydrogenating acetylene. Ethylene was, therefore, a more expensive product than acetylene and production techniques had to be adjusted accordingly.

PURIFICATION

Most of the acetylene produced in Germany was obtained from calcium carbide by well-known methods. Simple scrubbing techniques were adequate for the production of relatively pure acetylene. At one location, however, the synthetic rubber plant at Hüls, acetylene was produced by the electric arc cracking of methane-ethane mixtures obtained from coal hydrogenation or from natural gas. This is the first large scale application of this process and is of interest particularly in view of the problems encountered in purifying the gases. Similar problems are to be anticipated in purifying crude acetylene-containing gases produced by thermal decomposition, oxidation or other electrical methods.

At the Hüls plant the reaction is carried out using 7,000-v. d. c. at 7,000 kw. per reactor and each unit is fed with about 2,800 cu. m. of gas per hr. Yields from the operation are approximately 45 weight percent acetylene and 10 percent ethylene at a conversion of 50 percent per pass. The yield varies with the composition of the feed stream, with more ethylene produced at high concentrations of ethane. Carbon black and hydrogen form the remainder of the products in addition to some higher acetylenes, aromatics, etc.

In the reactor an arc is struck between a cooled upper copper electrode and a grounded copper gasket at the top end of the steel reactor. The gas passes downward through the reactor at 1.5 atm. and 1,600 deg. C. and is quenched at the outlet with a direct water spray.

After quenching to 150 deg. C., the gas is sent to two cyclones in series to knock out some of the carbon black. It is then sprayed with water and sent through a bag filter to remove the remainder of the black. Water is then condensed out by spray cooling to 20 deg. C. Higher boiling oils are removed from the crude gas stream by countercurrent oil scrubbing followed by high vacuum stripping of the rich oil. The gas is then water washed to absorb HCN and treated in iron oxide boxes to eliminate sulphur.

After this preliminary purification the acetylenes are absorbed in water at 19 atm. by countercurrent scrubbing. The nonabsorbed paraffins, olefins and hydrogen are then sent to a Linde plant for separation of the hydrogen and fractionation of the ethane from the ethylene. The ethane and methane are returned to the arc.

The absorbed acetylene is stripped out stepwise by flashing to a final pressure of 0.05 atm. The lowest purity streams are recycled and the remainder when mixed have a purity of about 90 percent acetylene. Final purification requires removal of CO_2 and higher acetylenes which is accomplished by low temperature condensation and evaporation followed by oil scrubbing. Traces of CO_2 are removed by a final caustic scrubbing and the gas purity is raised to 97-98 percent, somewhat lower than is obtainable from calcium carbide.

ETHYLENE COMPOUNDS

Most ethylene was produced by catalytic hydrogenation of acetylene over palladium on silica gel at 200 deg. C. using 100 percent excess hydrogen. The yield from this process is about 95 percent with the remainder largely ethane and to some extent butane. Ethylene was also obtained by dehydrating ethanol over oxide catalysts. Thus most of the chemicals made generally from petroleum ethylene in the United States were made in Germany from acetylene. These include the glycols, ethylbenzene for styrene and acetophenone, ethylene oxide, ethylene chlorhydrin, ethylene dichloride, dioxane, etc.

Of greatest interest in this group is the manufacture of styrene. Benzene is ethylated in a jacketed vertical glass-lined reactor, at 95 deg. C. and 1 atm. in the presence of anhydrous $AlCl_3$. The catalyst is continuously added at the top of the reactor and benzene, ethylene, recycle polyethyl benzenes and separated $AlCl_3$ complex put in near the bottom. The reactants are withdrawn in the upper part of the reactor, sent to a settler and the complex returned. Purification of the crude ethylbenzene is by conventional distillation.

Ethylbenzene is converted to styrene by catalytic dehydrogenation in the presence of a catalyst which is insensitive to steam and to which a water gas promotor is added. The reactors are vertical copper-lined tubes heated on the outside with flue gas to maintain 600 deg. C. in the reaction zone. The hydrocarbon feed is diluted with 1.25 times its weight of steam and passed downward as vapor through the catalyst in the tubes at 1 atm. pressure.

Purification of the styrene is carried out by low pressure distillation, using split towers for the separation of ethylbenzene to

prevent high reboiler temperatures. Polymer formation is prevented by tinning the towers, keeping temperatures low, and adding hydroquinone.

VINYL COMPOUNDS

Of greater interest is the large scale development of general processes to produce various vinyl compounds such as vinyl ethers, vinyl amines, vinyl sulphides and vinyl esters. Vinyl chloride is produced from acetylene and HCl by catalysis in the vapor phase over $HgCl_2$ on activated charcoal. Vinyl acetate is obtained using zinc acetate catalyst.

In the period 1930-1940 a group of workers at the I. G. Farbenindustrie under Dr. W. Reppe perfected general processes for the production of other vinyl compounds. It was found possible to insert acetylene between H and O, S, N or COO groups yielding vinyl ethers, sulphides, amines and esters. Ethers or sulphides are readily obtained by bubbling acetylene through the alcohol or organic sulphide at 159-200 deg. C. in the presence of 1-2 percent of potassium alcoholate. The pressure is fixed by the vapor pressures of the reactants, pressure being high enough to prevent boiling. In this way excellent yields can be obtained of vinyl methyl ether, vinyl ethyl ether, etc., and these can be readily polymerized to give products suitable for adhesives, coatings and pourpoint depressants. The products can be hydrogenated to form mixed aliphatic ethers.

An interesting development was being studied to give a new acetaldehyde synthesis. Vinylmethyl ether is easily hydrolyzed by dilute acid to acetaldehyde and methanol, and the methanol can be revinylated. This is an alternative to the use of mercury sulphate catalyst for producing acetaldehyde from acetylene.

No very important developments were made in the field of vinyl sulphides, although many reactions had been studied. In general the aliphatic sulphides are unstable after vinylation.

By using zinc naphthenate in place of KOH it was found possible to attach a vinyl group in the ring of phenol or substituted phenols. These materials polymerize readily, and one of them was found useful as a rubber tackifier (Koresin, made from isobutylphenol). Similarly zinc naphthenate is useful as a general catalyst to produce vinyl amines and vinyl esters of higher organic acids. The same general process is used as for ethers, using temperatures in the range of 150-200 deg. C. and at pressures sufficient to prevent boiling. Of greatest commercial importance was the vinyl ester of tall oil acids from sulphate pulp plants, and vinyl carbazole. The tall oil ester was found to be a good drying oil and the vinylcarbazole is a useful raw material for a fibrous and thermoplastic polymer.

AMERICAN INVESTIGATORS NOW IN GERMANY

American chemical engineers and chemists are now in Germany for intensive investigation and evaluation of I. G. Farben research in acetylene chemistry. The team is under the direction of the TIIB Chemicals Unit and is comprised of Edward N. Rosenquist and Wayne E. Alexander, Monsanto Chemical Co.; Horace M. Weir, D. L. Fuller and A. O. Zoss, General Aniline and Film Corp.; G. B. Carpenter, Air Reduction Co.; and Karl Kammermeyer, Publiker Industries. Costs will be shared by the companies with which the investigators are affiliated. Findings will be made public later through the Office of the Publication Board.

TRIPLE BONDED PRODUCTS

A major step forward in acetylene chemistry was made by Dr. Reppe and his associates in developing a method for inserting acetylene into various organic substances, making a carbon-carbon bond, and leaving a product with a triple bond. This reaction was found to go usually only in the presence of copper or silver acetylide catalyst. The process was used most extensively for the reaction of formaldehyde and acetylene to form butynediol. This was hydrogenated to 1,4-butylene glycol and dehydrated to butadiene. This was used on a large scale at the Ludwigshafen plant of the I. G. Farbenindustrie.

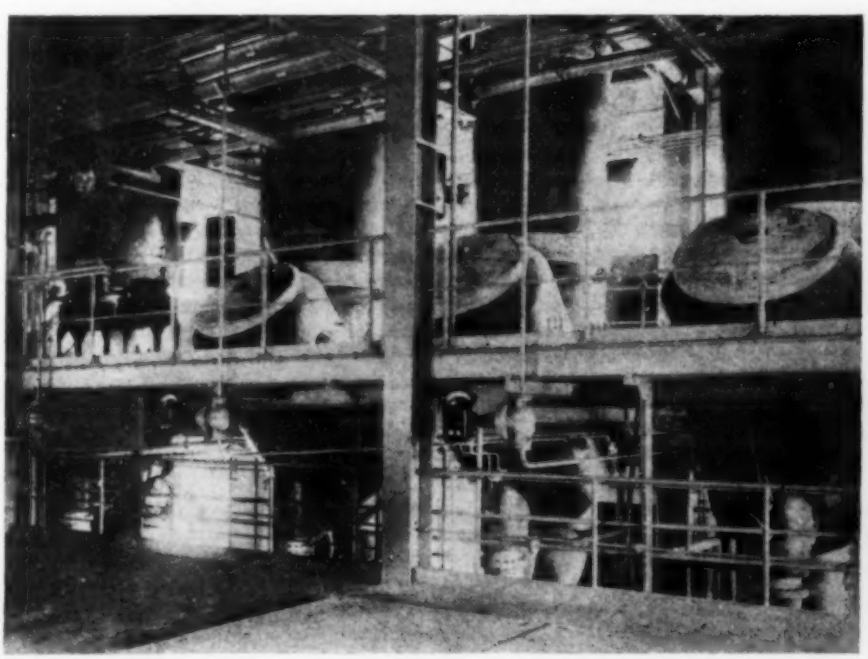
A 15 percent solution of formaldehyde and four times the theoretical quantity of acetylene is passed concurrently downward through a bed of catalyst composed of 12.5 percent Cu, 3.5 percent Bi on silica granules. Two reactors are used in series each 1.5 m. in diameter and 18 m. high. The reaction proceeds at 5 atm. and 80-120 deg. C. with nearly complete conversion of the formaldehyde in one pass and with 90-95 percent yields. Acetylene is recirculated to aid in removing reaction heat, which is further absorbed by vaporization of some of the feed. Bismuth is added to the catalyst to reduce cuprene formation which eventually plugs the catalyst bed after several months of operation. Purification of the butynediol is by conventional fractionation.

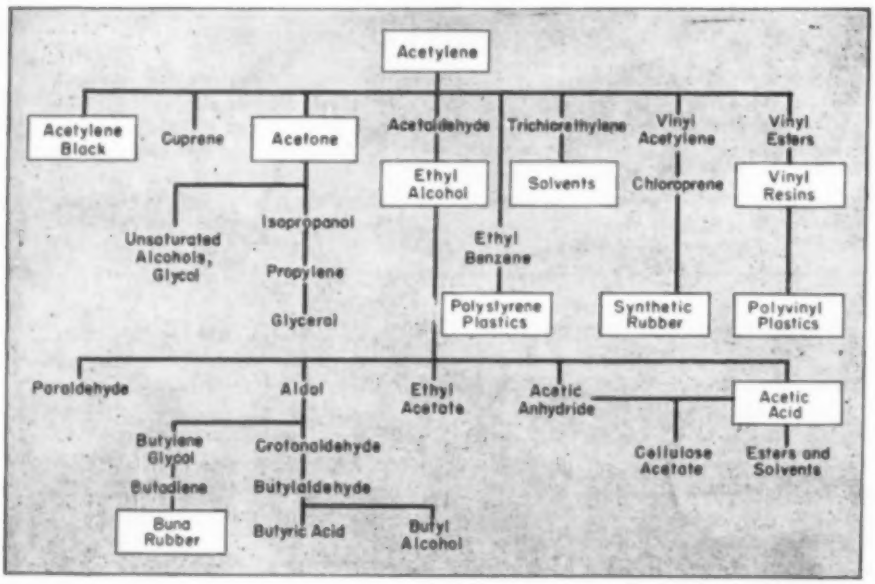
The same process is suitable for producing propargyl alcohol using somewhat modified conditions and operating with formaldehyde and acetylene in countercurrent. Substitution of acetaldehyde for formaldehyde leads to a series of compounds such as 2, 3-butylene glycol, piperylene and 1,4 dimethylbutadiene. Other aldehydes lead to similar products generally of higher molecular weight.

With ketones the reaction goes in the presence of KOH yielding a series of highly unsaturated alcohols or diols. Amines can also be treated in a similar manner using copper acetylide to yield aminobutynes. We have here, therefore, a general reaction for the production of many reactive, highly unsaturated organic substances, which can be hydrogenated, chlorinated, etc.

The hydrogenation of butynediol takes place at 300 atm. and 20-120 deg. C. in a vertical fixed bed reactor using a copper-nickel on silica catalyst. Large excesses of

Reactors for converting acetaldehyde to aldol at Huls





This chart shows the wide variety of products derived from acetylene. It could be extended to show an even greater variety of end products, but it is adequate to illustrate the importance of acetylene to Germany's industry and war economy

hydrogen are used to remove reaction heat.

Dehydration of the glycol may be accomplished in one or two steps. The initial dehydration is to tetrahydrofurane, which is obtained in almost quantitative yields by homogeneous liquid phase catalysis in the presence of a small amount of phosphoric acid at 100 atm. and 290 deg. C. Either this or purified glycol may be dehydrated to butadiene using a vertical, fixed bed reactor at 1 atm. and 280 deg. C. This step requires a sodium phosphate on coke catalyst which has about a three week life, and the reactor is supplied with heat by means of a series of horizontal pancake coils through which high temperature, high pressure water or steam is circulated.

This butadiene synthesis yields a number of interesting and useful intermediates for the production of many chemicals. Thus propargyl alcohol can be hydrogenated to allyl alcohol, *n*-propanol or propionaldehyde, or may be dimerized to hexadiindiol using oxygen and copper chlorite. Butynediol can be readily converted to ketobutanediol or to hydroxymethylvinylketone using mercury sulphate and the former hydrogenated to trihydroxybutane. Butenediol may be made in good yields using iron for a hydrogenation catalyst and this is readily dehydrated to dihydrofurane which in turn may be oxidized in vapor phase to maleic acid. Butenediol in liquid phase plus hydrogen peroxide yields erythritol, and if treated with HCN, dehydrated and hydrogenated leads to the dinitrile of adipic acid.

1,4 butylene glycol may be reacted with hexamethylene-diisocyanate to give a new type of plastic with the general properties of superpolyamides. Treatment of butylene glycol with copper at 200 deg. C. yields γ-butyrolactone which may be used as a raw material for many other products and which also is an excellent solvent for acetylene. By reaction with acetylene and ammonia butyrolactone forms vinylpyrollidine or Periston, a blood plasma substitute.

Tetrahydrofurane is of considerable interest as an excellent solvent for a large number of plastics such as polyvinyl chloride. Treatment of tetrahydrofurane with ammonia or amines yields pyridine or pyrollidines and the latter may be dehydrogenated to give the pyrolles. Tetrahydrofurane may also be split in the ring to yield polymers of general rubber-like qualities. Altogether, this new synthesis for butadiene opens up many paths for the production of materials now unavailable commercially in the United States.

CARBON MONOXIDE ADDITION

During the latter part of the war the Germans developed an interesting series of processes based on the direct introduction of carbon monoxide into an organic molecule by making carbon-carbon bond. This was found to be possible with nickel carbonyl as a catalyst.

By using acetylene, carbon monoxide and water the reaction leads directly to acrylic acid. Substituting alcohols for water permits the formation of the esters. For example, ethyl alcohol yields ethyl acrylate when reacted with acetylene and carbon monoxide.

Tetrahydrofurane reacts in a unique manner with carbon monoxide and water to form adipic acid. In this case tetrahydrofurane shows the same tendency to split in the ring as is found in the production of tetrahydrofurane polymers. All three of the above reactions and modifications of them are of potential interest as alternate methods of production to those common in the United States today.

It was generally known prior to the war that Germany was producing butadiene from acetylene through acetaldehyde, aldol and 1,3-butylene glycol. The details of these steps were not generally known, however.

BUTADIENE SYNTHESIS

First step in the reaction is to pass acetylene upward through a rubber-lined reactor filled with catalyst solution. The acetylene, mixed with steam, bubbles through about one ton of mercury in the cone base of the reactor which is 1.3 m. in diameter and 15 m. high. Most of the reactor is filled with a solution containing approximately 0.5 g. Hg, 36 g. Fe^{+++}, 4 g. Fe^{++} and 200 g. SO_4 per liter. In an expanded section of the reactor near the top the vapors are separated from the liquid, the latter being returned to the reactor base. The operation is conducted at 95 deg. C. and about atmospheric pressure near the reactor top. The vapors are cooled in several steps and passed to a cyclone to knock back as much entrainment as possible. Final cooling to 60 deg. C. followed by scrubbing yields a 7 percent solution of acetaldehyde which is purified by distillation. Catalyst solution in the synthesis step is kept at constant composition by oxidizing a slipstream with nitric acid. Yields on this process are 94 percent of theory at 55 percent conversion of acetylene per pass.

Aldoling is quite simply handled by means of rapid circulation of acetaldehyde in contact with 0.1 percent KOH at 20 deg. C. through a horizontal tubular heat exchanger cooled with water. Conversion is held to 46 percent per pass to prevent side reactions and the ultimate yield obtained is about 88 percent plus about 6 percent unconverted aldehyde which finally is recovered after hydrogenation as ethanol. The solution is then treated with dilute phosphoric acid at a pH of 8.0 and the potassium phosphate separated by settling, centrifuging and filtering. The aldol is then concentrated by distillation to about 73 percent.

The hydrogenation step is very similar to that used for butynediol, except that the catalyst used is 20 percent Cu, 1.0 percent Cr on silica. Hydrogen and aldol are passed downward through the catalyst bed at 300 atm. and an inlet temperature of about 60 deg. C. The outlet temperature varies with catalyst activity from 70 to 160 deg. C. The conversion is complete in one pass with a 93 percent yield. Pure butylene glycol is obtained by distilling the crude product. (Some work was also done at 700 atm.)

The dehydration of 1,3-butylene glycol is similar in many respects that of 1,4-butylene glycol. However, the catalyst is not dehydrated quite as far to pyrophosphate. The vaporized feed plus steam is allowed to pass upward through the catalyst bed at 280 deg. C. and 1 atm. In this case conversion is nearly complete in one pass with an ultimate yield of 81 percent after re-

cycling the allylcarbinol which is produced to the extent of 10 percent. The butadiene is then purified rather easily by fractionation to give about 61 percent yield based on acetylene.

OTHER PRODUCTS

A number of synthetic rubber products were produced based on butadiene and styrene. These were made with various proportions of the two monomers. In addition to these buna-S types, two polybutadienes were produced. One of these, buna 32, was made batchwise using sodium dispersed in xylene as the catalyst. This material was of low molecular weight and was of value largely as a rubber softener. Buna 85 was produced continuously in a horizontal jacketed autoclave internally equipped with a rotating screw using potassium as a catalyst.

The production of acetaldehyde made possible the manufacture of large quantities of acetic acid and acetic anhydride by conventional methods. Many byproducts and intermediates obtained in the synthesis of butadiene were recovered and converted to useful products in modern tonnage. One interesting research development was the production of a mixed aldol of acetaldehyde and propionaldehyde, which upon hydrogenation and dehydration yielded isoprene.

A large part of Germany's wartime organic technology was based on acetylene and many new and ingenious developments were made both in laboratory and plant. Some of these developments will be of use in the American chemical industry, and in particular many of the new commercial products will be of interest although they may be made more cheaply by other means. Finally, the long and careful research into the properties of acetylene and the conditions for its safe handling will add appreciably to our technology.

Notes on the German Carbide Industry

L. WILSON GREENE

Senior Consultant, CWS Technical Command
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PRIOR to the war, the annual production of calcium carbide in Germany amounted to approximately 900,000 metric tons (1937). As the result of building additional carbide plants, increasing the capacity of existing furnaces and expanding electrical power facilities, the annual production during the war reached almost 3,000,000 tons.

The importance of carbide in the chemical economy of a modern industrial nation is realized when we consider the large number of essential end products derived from it. In Germany before the war, half of the carbide went into the manufacture of calcium cyanamide (nitrogen) fertilizer, and about one-tenth was converted into acetylene for oxyacetylene cutting and welding. By far the most important use of carbide during the period of hostilities was in the manufacture of acetylene, which served as a starting material for several synthetic chemical processes.

These processes include the manufacture of butadiene and styrene which are co-polymerized to make buna synthetic rubber. Chloroprene synthetic rubber; polyvinyl, methacrylate and phenol plastics; and such compounds as ethyl alcohol, acetaldehyde, acetone, ethylene glycol, trichlorethylene and numerous esters and higher alcohols are all products of the so-called "acetylene chemistry." A carbon black (acetylene black) is produced directly from acetylene.

The largest chemical plant in the U. S. Occupation Zone is the former I. G. Farbenindustrie works located at Höchst, near Frankfort a/Main, which at normal capacity employed 11,500 workers. One of the newer sections of this plant comprises the acetone-acetic acid department where alcohols, esters and "Mowolith" polyvinyl acetate resins are made. To meet Military Government requirements during 1946, it was estimated that the department would have to be supplied with the following chemical commodities:

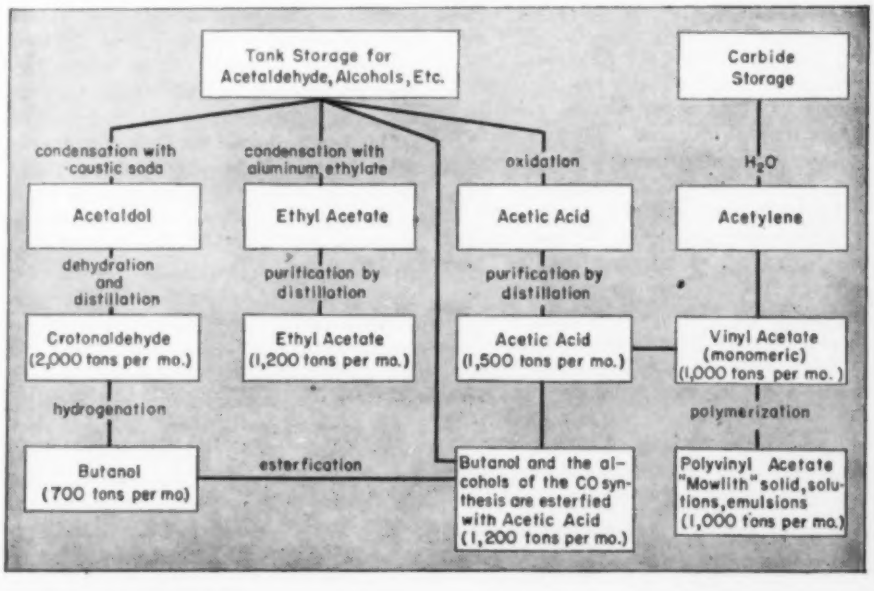
Commodity	Metric Tons
Calcium carbide	500
Acetaldehyde	400
Methanol	300
Ethanol	100
Formaldehyde	60
Urea	35
Phenol	20
Hydrogen, cu. m.	120,000

This operation, representing but a small part of the German chemical industry dependent on carbide as a basic raw material, is used here as an example of the monthly tonnages of chemical commodities required even under strict Military Government control.

There are two major carbide-producing plants in the U. S. Zone: the Hart Plant of Süddeutsche Kalkstickstoffwerke A. G. and the Burghausen Plant of Dr. Alexander Wacker, Gesellschaft für Elektrochemische Industrie m.b.H., both in Bavaria. The entire postwar carbide output of the Hart Plant was allocated for the capacity production at Trostberg of 27,500 tons of cyanamide per month (equivalent to 5,500 tons of fixed nitrogen), leaving the Burghausen Plant to supply carbide for all other Zone requirements, especially for the manufacture of acetylene for use in clearing demolished bridges from waterways and for essential demolition work and reconstruction. While there are production facilities in the British, French and Russian Zones of Occupation, the requirements in each Zone exceeded capacity and in the early stages of occupation, there was very little interzonal trade in this commodity.

The war potential of the carbide industry (explosives, rubber, plastics, etc.) has been studied carefully by the occupying authorities, and only such capacity as will be required for the absolute minimum civilian needs will be permitted to remain in Germany.

Flow diagram of operations at the acetone-acetic acid department of the former I.G. works at Hochst, largest chemical plant in the U. S. Occupation Zone


Tank Storage for Acetaldehyde, Alcohols, Etc.
Carbide Storage
condensation with caustic soda
condensation with aluminum ethylate
oxidation
H_2O
Acetaldol
Ethyl Acetate
Acetic Acid
Acetylene
dehydration and distillation
purification by distillation
purification by distillation
Crotonaldehyde (2,000 tons per mo.)
Ethyl Acetate (1,200 tons per mo.)
Acetic Acid (1,500 tons per mo.)
Vinyl Acetate (monomeric) (1,000 tons per mo.)
hydrogenation
polymerization
Butanol (700 tons per mo)
esterfication
Butanol and the alcohols of the CO synthesis are esterfied with Acetic Acid (1,200 tons per mo.)
Polyvinyl Acetate "Mowlith" solid, solutions, emulsions (1,000 tons per mo.)

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Industrial Trends Set the Pattern for RESEARCH

There are two morals to this "brief research in research." First, a company without research is almost certainly doomed to slow suicide. And second, the kind of research most likely to pay for itself is that which is aimed at new products—especially products that ride the trend toward "functional engineering," but above all, products that broaden and diversify the base of the business.—*Editors*

RESEARCH is the one function of business which, far more than any other, deals with the future. We are all going to live in the same future. We all have a growing concern about that future. And so we are all interested, in one degree or another, in what is sometimes called the "research game." We all want to learn a little more about it, whether we are old and confident hands at the game, new and timid players for small stakes, or merely uncomfortable kibitzers who are afraid to stay out but still more afraid to join in.

It may be undignified to refer to industrial research as a gambling game, but it is certainly not unfair. Any money placed on a future uncertain event is by its very nature a gamble. It would only be kidding ourselves to say that research always produces a profit and never a loss. The kibitzer has tended to stay a kibitzer only because he has seen too many people lose their shirts in research. And many a player has felt like becoming a kibitzer again when he found that the measure of his success was getting back no more than half of what he put in. We like to refer to industrial research as a kind of insurance of manufacturing profits, but it is far from an exact science. Nobody yet has been smart enough to figure out the risks and premiums on a sound actuarial basis.

If industrial research is no more than a gamble then, two questions are very much in order. First, the kibitzers are entitled to inquire why they should change their practice—why, for example, it is any less foolish to spend money on research than to bet on the ponies or to speculate in the stock market. And secondly, those who already are risking their money on research may well ask if anything can be done to tip the odds more in their favor, and if so, what it is.

Now since we're talking about research, let's use the methods of research in trying to find some kind of an answer to those questions. Let's see what we can learn by making a brief research in research itself.

THE BIGGEST GAMBLE: NO RESEARCH

It doesn't take very much research to show that the biggest possible industrial gamble is to do no research at all. The reason is obvious. Doing no research doesn't mean simply that your earnings will stay as they are. Your greatest need for research is not to raise your profits but to preserve them. If the voice of experience says one thing louder than anything else, it is this: Like Alice in "Through the Looking Glass," industrial corporations must run faster and faster if only to stay in the same place.

This is proved conclusively by the records of both the Department of Commerce and the Bureau of Internal Revenue—and I am talking about long-term or secular trends and not short-term or cyclical movements. These records show that corporations often have considerable stability for many years in their capital account, that is, their investment in plant and machinery. But the records also show they have no such stability in their sales and earnings. The output of individual industries and the profits of individual companies are almost always trending either upward or downward. Few of them stand still for very long.

Take any single company as a case history and check its record over a score of years. You will see, of course, that its total earnings at any one time is no more than the sum of the earnings of all its products at that time. And you will also see that each of those products has, from the standpoint of the profits it may yield, a pattern of life much like that of a human being. It has a birth, a peak of productivity, and an ultimate demise. And no one product is immortal. However impressive its record may be, an ultimate decline is inevitable, and the only question is how soon and how fast.

But, you say, this all may have been true enough in the fast-moving years of the remote past. Rapid change was only to be expected in those highly competitive years between the Civil War and the first World War. But in the following years we saw no such sweeping change as the replacement of the canal by the railroad or the buggy by the motor car. In the last long interval of peace—in the twenty years between the two World Wars—things began to settle down. The total output of all manufacturers then increased no faster than the country's population, and the Federal Reserve Board production index was no higher in the late thirties than in the early twenties. We are told that the country is approaching economic maturity. We are told that competition is declining. Why can't we lean back and relax in this new era of calm and serene stability?

Now that unchanged Federal Reserve Board index of total production was only a blind facade that concealed a multitude of sharply conflicting trends. It was almost as if the various industries of the country, when denied an outlet for their energies in the form of normal growth, turned on each other in a species of civil warfare. As one industry or company grew, another declined in like proportion. Such stability as we achieved, therefore, was only a stability of the averages. It resulted from an equal balancing of gains and losses, and was a dynamic rather than a static equilibrium. In other words, it was the same sort of stability that comes to the population of some little community when the birth rate exactly matches the death rate.

Technology, of course, is at the root of

From an address before the New England Research Conference of the New England Council, Boston, May 16, 1946.

all such change. And, since our national expenditures for research are growing by leaps and bounds, the rate of industrial change is not slowing down. On the contrary, it is accelerating. Both the birth rate and the death rate of our community of manufactured products are climbing at a startling rate. Its total population of products may remain the same, and the industrial community as a whole may continue to look the same to the abstract statistician. But within that community is everything calm and serene? Are you content to stand idly by and let nature take its course? Are you prepared to accept a continuous foreshortening of the life expectancy of the products which you manufacture?

If not, you must do battle with the rising force of technological obsolescence. And in doing battle with that force you must invoke the one power which is its master. That power is technology itself. Technology is both an opportunity and a threat—an opportunity to the company that takes full advantage of it and a threat to the one that doesn't. But recognize also that you may seriously cripple the power of technology if you keep it forever on the defensive. Obsolescence does not always make a direct attack from the front but often simply circles around its opposition. Your product may be made obsolete, in other words, not so much by the same thing offered by the other fellow at a lower price but by something quite different which performs the same function in a better or cheaper way.

In industry as in war, therefore, the best defense now lies in attack. The psychology of the Maginot line no longer has a place in a well-planned technological campaign. Paradoxical though it may sound, the only really conservative attitude which can be taken today toward the preservation of your profits is a deliberate policy of intelligent risk-taking. The biggest gamble is to do no research at all.

SET ODDS IN ADVANCE

But suppose we choose the lesser gamble and decide to risk research. What, if anything can we do to cut down the odds against us? Again a little research in research comes up with a decisive answer.

The most important thing of all is obviously to choose the right project. It is before we actually start any experimental work that, consciously or unconsciously, we do the most to set the odds either for or against ourselves. Unfortunately, however, the choice of the project is often more difficult than its subsequent solution. A rare combination of business vision and technical insight is required to select the field which is most fertile, whereas the talent can usually be found to raise crops on the most sterile of ground.

In choosing the particular field in which to do research, you may find it advantageous to break away from some of the traditions of the past. You may decide, for example, that the earlier functions of research have become too narrow to suit your purpose.

Of the earlier functions of research the oldest was that of "first-aid." Some company perhaps found itself in trouble with a product going off quality or with an operation losing its efficiency, and it called on the chemist or the engineer for help. This first, or remedial, function was then superseded in importance by its second, or preventive, function, which still accounts for the biggest part of the research budget of the average company. Research of this type represents a sort of "Life Extension Institute," which is designed to improve the quality, to lower the cost, and to avoid loss of markets for the already existing products of that company.

In recent years, however, many companies have discovered that research of this second type, while almost uniformly beneficial to their customers, has not always been equally beneficial to their stockholders. This is particularly true of products which are sold in markets that are no longer very elastic and that have become much more heavily weighted by replacement than by original sales. Under such conditions, a substantial extension of the useful life of a product and a drastic reduction in its price may harm rather than help total profits. Because of this fact, increased emphasis is now being placed on a third function of research. And if the first was remedial and the second was preventive, the third function can only be called obstetrical. One of the strongest of current technological trends is a growing tendency for one manufacturer after another to bring out new products and to enter new industries in which they have not previously competed.

Here, then, is our simile of death rates and birth rates reduced to its simplest terms. Here, on the one hand, accelerating the death rate is technological obsolescence in the form of increased competition not simply from familiar companies in the same industry but from unfamiliar companies in other industries. And, here on the other hand, accelerating the birth rate is the growing recognition by industry of the need of these new products themselves. It is the belated recognition of the fact, not always fully appreciated in the past, that corporate earnings can no more be perpetuated without new products than family names can be perpetuated without new children.

But how is a new product to be chosen? The history of research indicates that the odds in favor of the project are most favorable when, first, the product to be developed is riding a rising rather than a declining industrial trend, and secondly, when it is started in the earlier rather than the later phases of that trend. This is very elementary, of course, and merely passes us on to the next question: How are these basic trends of industry to be recognized in time to get in at the beginning?

Only one reliable method of forecasting the future has ever been developed, and that method consists in projecting the continuing trends of the past. Also, projections—especially those of a broad fundamental nature—are the more reliable the further back they are started. Hence, any serious attempt to review the underlying trends of this country should start as far back as the Civil War, when the transition of our economy from an agricultural to an industrial type first began in earnest.

TRENDS IN TECHNOLOGY

Such a review covers eighty-odd years and must necessarily be very brief. Of the trends which deserve special mention, however, one is technical in nature. It shows that technology, the great inducer of obsolescence, has been by no means immune itself to obsolescence. The various types of technology have all had their own periods of individual ascendance and decline. If you will pardon a little over-simplification, therefore, those eighty years may be divided into four periods or "eras," each twenty years in length and each characterized by one particular type of engineering:

1860-1880 was the era of the civil engineer. It was the period of the nation's greatest geographical growth, when the west was being opened up and the country was being physically built. It was the period of construction of both canals and railroads, the former already in their declining years and the latter just rising toward the peak of their importance.

1880-1900 was the era of the electrical engineer. Of Bell and the telephone. Of Edison and the electric light. And of the rise of electrometallurgy. Hall and aluminum, Wilson and calcium carbide, Acheson and graphite.

1900-1920 was the era of the mechanical engineer. Of Olds, Selden, Ford, Winton, and the automobile. Of the Wright brothers and the airplane. Of the development of prime movers of all sorts and the greatest application of power to industry. It was the period of refinement of machine tools and labor-saving machinery. Of the development of the principle of interchangeability in manufacturing and the resulting rise of mass production of articles of all descriptions from tanks to carpet tacks.

1920-1940 was the era of the chemical engineer and the metallurgist. Of the manufacture in this country of many chemicals previously imported before the first World War. Of the rise of the process industries: petroleum refining, glass, paper, rubber, and non-ferrous metallurgy.

There was, of course, no line of sharp demarcation between these four "eras." Also, the civil, electrical and mechanical engineer are far from obsolete today. All types of engineering have continued to grow, but their rates of growth have been much different at different times. And we can read

the record of the ascendancy of each successive group in the changing proportion of membership in the different technical societies, in the number and types of patents issued, and in the relative volume of technical literature in the various fields.

We can also read that record in the history of the stock market, although the industrial effects of technological innovations often do not reach their maximum until some later generation. We see the activities of the civil engineer, for example, reflected in the rise of the rails, which in 1890 accounted for most of the stocks and bonds listed on the New York stock exchange. We see the electrical engineer in the emergence around the turn of the century of stocks such as Western Union, General Electric, and that pioneer electric utility holding company, Oregon & Transcontinental, now North American. Then, in the period following 1900 we see the mechanical engineer in the great increase in the unit size of the average manufacturing corporation, a trend that did not run its course until industrial stocks far outranked both the rails and utilities in their total market value. And finally, after the first World War, we see the chemical engineer in the sharp and sudden rise of the chemical stocks to first place in dollar value among the industrials.

THE NEXT TWENTY YEARS

But what about the next twenty years? Are we still in the era of the chemical engineer? An examination of the principal trends of the recent past indicates "no" as the best answer to this question. It is a qualified "no," however, because industrial chemistry still has before it the period of its greatest growth. Nevertheless, it seems safe to forecast that the period from 1940 to 1960 will not be characterized by the ascendancy of any single branch of technology, whether of the old conventional type or of some new type such as "electronic engineering." Instead, it seems much more likely to be characterized by the further breaking down of such barriers and boundaries as still exist between the present technologies.

This conclusion is not spectacular and may even be regarded as disappointingly vague. Perhaps an illustration will help. Chemistry and physics were once considered separate sciences, but what would be the industrial status today of ammonia and other products of high pressure synthesis if chemistry hadn't learned from physics the principle of the phase rule and other laws of thermodynamics?

Another basic industrial trend relates to the changing position, technologically speaking, of the consumer relative to the producer. Research in the future is going to work more for the consumer and less for the producer. Recall that research to date has been pretty much in the hands of the big companies and that the big companies have been mostly the primary producers and refiners of materials of all sorts. The objective of such research has been to force a maximum of nickel, aluminum, copper, gypsum, asbestos, plastics, and what have you into as many different markets as possible. It is a technology of adaptation.

It does not require much imagination to realize, however, that only through coincidence would the products resulting from such research happen also to be the most suitable for the purpose in question. Who will admit, for example, that the best roofing, the best wallboard, and the best flooring that we can buy today are really the best which can be designed? Suppose, for example, that a research department were not committed to use some one material in large part but had complete freedom to select, in type or quanity, any material or combination of materials that best fitted its purpose. Then, isn't it only reasonable to believe that the researchers could produce something representing a better compromise of cost and performance than the best now offered on the market today?

It seems safe to predict, therefore, that in the future a smaller proportion of the country's total research effort will be upon adaptation—the forcing of a given material into a given market whether it has an inherent right to be there or not. There is reason to believe, on the other hand, that more attention will be paid to a new type of technology. Such technology takes the customer's point of view, and can best be described as functional engineering. Research of this type is most willingly financed by companies that own no mines or quarries, that have little or no stake in specific commodities, and that hence can be more objective in their choice of materials.

Functional engineering is almost always characterized by an increased emphasis upon the principle of composite construction. When it is practiced more widely, we shall see many fewer products made largely of metal, wood, paper, textiles, plastics, or of any single material alone. We shall see, in their place, many more articles representing combinations of such materials, in which each material serves best its own particular function in a way that lowers the net cost of the final product at no sacrifice of quality.

RESEARCH OPPORTUNITIES

This increasing interest of the technologist in the consumer, and this growing recognition of functional engineering, spell real opportunities in research. If we take a concrete example—the New England region makes a good case in point—we can see how these research opportunities can be realized in practice.

This particular corner of the United States has long ceased to be an important producer of prime commodities. Its mineralogy is unsuited for either mining or farming, and its geography is adverse to the shipping of heavy tonnages on a national scale. And in low-cost labor and low-cost power it cannot hope to compete with the states south of the Mason and Dixon line.

If New England is not to become, therefore, as some of the older European countries have become, a purveyor chiefly of scenery and history to the tourist trade, it must obviously continue as a fabricator of the basic raw materials produced by others. But if it is to hold a leading position in the fabricating art, it must find new and better methods to overcome its regional handicap of higher-than-average freight rates and labor costs.

The broad field of composite construction merits most serious consideration as a possible solution of this problem. It promises, in the broadest sense, to make full use of the greatest of New England's assets, namely, its yankee ingenuity and resourcefulness of management, its great reservoir of highly skilled labor, and its demonstrated talent in engineering and chemistry which is backed up by some of the country's outstanding technical institutions and research organizations. And it promises, in a minor sense, to tap the specialized familiarity of New England with materials such as pulp, paper, and plastics, and with products such as shoes and textiles.

Specifically, the manufacturers of this region should officiate more frequently at industrial weddings of the sort just mentioned. They should carefully investigate what unions they can promote to the advantage of the community in general and themselves in particular.

The number of combinations and permutations of available raw materials is now so great that many new products are waiting to be born which would represent a substantial improvement over those already in existence.

Let us suppose, for purpose of illustration, that you want to make something by the union of a fiber with a plastic. Examine, on the one hand, all the fibers which are low in cost and which can impart bulk or strength to the finished product. Consider, for example, not simply cotton and wood pulp, but also asbestos, glass, and even metal. Then determine, on the other hand, what plastic will give to the finished product the necessary rigidity or flexibility, the hardness or softness, the opacity or transparency, or whatever other property you may have in mind. You can make anything from a non-absorbent tablecloth to a shock-resistant gear, from a covering for floors to a container for coffee, from a shoe sole to a clock housing, and from a suitcase to a bathtub. And don't let lack of imagination hold you back. One manufacturer is reported already to be experimenting with summer suits woven from extremely fine copper wire coated with a cellulosic plastic.

The impact of technology is falling, moreover, not only on old-established materials but also on old-established methods. In the textile field, for example, the makers of machinery and the processors of cloth can't sit

(*Continued on page 129*)

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MANAGEMENT
Of the Well Developed Research Program

We have seen from the preceding article that research is a necessity and we have some general guide posts to the fields where profits lie. But there is more to research than being on the right track. There are many elements in a full blown research program, and it takes efficient management to keep everyone pulling together.—*Editors*

Few indeed are the skeptics who do not believe implicitly that great changes are just around the corner in everything concerned with our living habits. Continual improvement in product and process is taken for granted by businessmen as an essential philosophy for the successful company. Hence it is necessary that managements give painstaking study to the means by which their products can rise to the demand of the public for progressive betterment.

The accepted way for a company to develop new or improved products is to assign technical specialists to the job, in other words, to set up a research program.

SIZE VS. COORDINATION

The major problem in a small company is to find the time of a competent man or men in a limited organization to carry on systematic experimentation. Once the new product or process has been worked out, its commercial development can be handled through the tightly knit managerial group, in which contact with production and sales is necessarily very close.

In a larger company, by contrast, when the management has decided to embark on research, it is easier to set aside a group of specialists to develop new and improved products. Financial and personnel limitations are lessened. But then the major problem becomes the coordination of the research group with the operating departments in such a way that the full fruits of a systematic approach to better products can be realized.

In the following discussion of the management problems of a research department I have in mind a group of several well-trained technical men set up as a staff division. The size might be anywhere from, say, six to several hundred. The advantages and disadvantages of size tend to counterbalance each other to some extent.

A great deal of analysis is being devoted to the techniques of research administration. Such subjects as size of budget, laboratory organization, selection of personnel, and choice and planning of problems, are continually being discussed among research directors. There are several more or less formal groups of technical executives which have been organized for this purpose. Lecture courses on this subject have been instituted in at least one university.

It is widely recognized that the research director should report to a general executive of the company, or should himself be a company officer. By this means, the program is given a status that protects it from the encroachments of sales service or production trouble shooting, which can easily become restrictive. Both these functions are essential technical activities in larger companies, but they should not dominate the longer range research work.

Research directors should be selected on the basis of executive, technical, and business abilities. *Esprit de corps* is an essential factor in research and the head of the department must command the respect of those whose work he is to guide. From his own background he must be able to understand sympathetically the exhilirations and disappointments that are the lot of the research man.

A considerable element in the success of a research program lies in the proper selection of technical men. The executives of the department necessarily devote extensive time to personnel problems. It is not merely a question of selection, but also of guiding the development of men into best use of their talents. Some will find their greatest satisfaction by remaining in the laboratories, while others show sales or production leanings and move into these departments as new products or processes pass into commercial stages.

SELECTION OF PROBLEMS

One of the most critical factors in the development of a research program is the selection of problems. The projects should be analyzed on the basis of technical feasibility, economic soundness, sales prospects, production aspects, and over-all policy. It is all too easy to embark on a long and costly investigation that eventually runs on the rocks because it does not adequately meet these requirements. Periodic appraisal of progress on each project should be made. A systematic reporting system is of great aid for this purpose.

A balanced program of shorter-term and longer-range projects is advisable. If all the work is fundamental research, laboratory morale and support of the management may suffer in the long wait for practical results. On of the other hand, if the entire program is directed at immediate objectives, the chance of making far-reaching contributions to the company's business is reduced.

COORDINATION

The success of research often depends upon the extent of cooperation that can be established with other departments of the company. It was pointed out above that projects should be critically analyzed from the points of view of sales prospects, production aspects, economic soundness and over-all policy. Such analysis is best made with the aid of the proper groups outside the department. Furthermore, when the new product or process comes to its final test, commercialization, this big step is most easily taken if the operating departments are already fully acquainted with the

(*Continued* on page 129)

From an address before the New England Research Conference of the New England Council, Boston, May 16, 1946.

HAROLD LADD SMITH *Research Director, Vermont Marble Co., Proctor, Vt.*

A Research Program to Fit the Budget of SMALL INDUSTRY

A small manufacturer cannot afford research on the grand scale suggested by the foregoing article, but that doesn't mean he cannot afford to study his problems systematically. Here is a down-to-earth program for getting started on self-improvement, with some practical pointers for getting the most from your research dollar.—*Editors*

SOME LARGE industries spend 5 to 6 percent of gross sales annually on research. Such a figure is probably beyond the means of the small manufacturer but the pity of it is that generally speaking these smaller companies do not engage in any systematic research. If your company is one of those that is conducting no research at all, it might be because you have found difficulty in making the start; someone has to "stir his stumps."

As a basis for getting started, suppose you sit down with your partner or shop foreman, take pencil and paper, and put down a list of things under the heading, "What I wish could be changed in my business." You've talked about it before but this time make a list in black and white. Your problems will probably arrange themselves under such headings as:

Better raw materials or possible use of cheaper materials.

An improvement in the old product with new uses and a broader market.

Better manufacturing supplies and accessorics.

Cheaper manufacturing methods.

Reduced spoilage.

Byproduct use of waste.

Better design.

Improved packaging.

An entirely new product.

The minute you formulate such a list and acknowledge to yourself that there are definite problems to be licked, you are ready to start research. The important thing is that you, the owner, superintendent or operator, are the expert. You don't need an outsider to begin systematic consideration of these facts. Pick two or three of the problems that seem most likely of solution or marked improvement. Progress on these will encourage you to go on to those more difficult. Start modestly with your raw material and your present finished product. Write out as problems to be tackled such basic headaches as these: Can we improve quality by use of better raw materials? Should we investigate cheaper raw materials? How can we reduce spoilage and defective goods? Can we modify or redesign our product to make it easier to use, more effective to the user? Can we use better supply and accessory items that will reduce our trouble with cements, glues, paints, solvents? Can we reduce manufacturing costs with new type machines, jigs, fixtures?

Any one or a dozen such questions call for study and experiment. Think through how you are going to conduct the test and list the things you are going to need, such as: Some old and new style raw material, samples of supply items to be tested, some weights or a saucepan or thermometer, maybe the kitchen oven or refrigerator at home.

PICK YOUR MAN

Choice of your experimenter presents your first major decision and must be done wisely. Generally speaking the average workman is a poor one to be entrusted with your tests. He is apt to be prejudiced or impatient. He resists change. Your most likely choice will probably be a younger person not too steeped in established practice, one who isn't impressed with all the reasons why a thing won't work. Arrange that part of his time at least will be spent on research. Be sure you make it perfectly clear to him what it is you want to find out. Encourage him to use his imagination.

If you do not have a suitable individual already in your organization, you will want to consider employing a man with technical training. In that connection, it will pay you to look over your hometown's returning G.I.'s. Many received technical training or experience while in service. Let him undertake your research problems under that part of the G.I. bill of rights, public law No. 346, which permits the veteran to receive on-the-job training from properly certified business establishments. Under this law the veteran gets a monthly salary from the government of up to $65 if single or up to $90 if married. He can also get necessary tools and supplies up to $100 in value. Every veteran is entitled to at least one full year of training and additional years for each year of service. The employer pays a regular starting wage and gets the benefit of the training. See your local Veterans Administration or U. S. Employment Service for guidance in this matter.

OUTSIDE HELP

Early in your program look for sources of outside help. You will be more likely to arouse outside interest if it is apparent that you have thought through and formulated a specific proposition. A half-cocked, hazy appeal will get you nowhere.

Your suppliers are your most likely source of helpful suggestions. The salesman may at least know how someone has met a similar problem. But don't expect the salesman to be a font of technical knowledge; if the solution of your trouble promises to increase the use of his product, he will arrange for a visit from one of their technical men.

Another source of help to small industry is to be found in the state colleges and universities, the so-called land grant colleges. You help support these institutions with your taxes and you are entitled to their help on industrial matters. Contact them. You may be surprised to find them well equipped to carry on your investigation or to advise. Or for a reasonable sum you may establish a fellowship at the college to study your particular subject under expert supervision and with adequate facilities.

Do you belong to a trade association? Are they conducting cooperative research? Are

Condensed from an address before the New England Research Conference of the New England Council, Boston, May 16, 1946.

you getting all the help you can from that source?

Subscribe to trade journals and try to keep up to date.

Avail yourself of Federal Government bulletins. Find out what literature there is of this kind in your field. Keep in touch with government experiment stations.

DANGER! BEWARE!

There are many pitfalls in the path of a research program. Above all, approach the problem methodically. Have a plan. Too often procedure is haphazard. Don't draw final conclusions from single tests. Keep careful records; they are vital. Write down what is done, when it is done, and the observed results. Don't trust to memory.

It is imperative that you show your research worker that you are optimistic; instill in him your faith that he can help solve the problems of the organization. Management must sincerely believe in research or it fails.

The location of your investigations is important. Keep them out of the way of normal production. A separate room is desirable where the work can be done without interruption and where the worker will be protected from too much discouragement from the wiseacres.

Don't expect revolutionary results at once and throw the whole idea out the window because of early failures. Research is a long term proposition: it gathers momentum.

Start out by working on existing products or methods. Opportunities to improve existing items or reduce costs are more immediately apparent. But do not neglect the possibilities of research as a source of new products. That is where most new ideas have come from.

Stick to applied research. With time and funds limited, the small manufacturer cannot become involved in basic and fundamental research that is not applicable to immediate problems.

At least once a year review the studies that turned out discouragingly. You might decide to try again in the light of more recent experience.

Don't overlook the fact that expenses for research is a properly deductible item in figuring your income tax. That's another reason for accurate written records.

Perhaps you have already tried this sort of research and feel that it got you nowhere. Maybe so, but perhaps you went at it in a rather haphazard way, without much faith that the job could be done, with little control, with limited patience, and with no written records.

If that is the case you should consider another attempt, because research does pay, maybe not immediately, but within a reasonable period. It has saved the life of many struggling companies and marked their beginning of growth and security. In the face of competition research is a must. Properly directed the expense becomes an investment.

RESEARCH MANAGEMENT

(*Continued from page 127*)

development, or better still, have actually taken part in a periodic review of progress.

A shortsighted policy is to be avoided regarding working facilities for research men. Research is expensive and salaries for a department often rise to an imposing total. If competent men are hired, they should be given the tools they require. Broadly speaking, this applies not only to laboratory equipment and space, but also to machine shop, library, office, and patent services, and even to the dispatch with which such services can be used by the staff.

In certain branches of industry new products or processes are eased into commercial production through an intermediate or pilot scale operation. Experience has demonstrated the effectiveness of this procedure for correcting difficulties in process with smaller equipment and smaller amounts of raw materials.

In a similar way the use of "pilot sales" or market development is becoming more general as a means of studying the reaction of a representative group of customers to a new product.

The combination of pilot plant production and pilot sales is an ideal stage for enlisting the full cooperation of the operating departments for final evaluation before commercialization is attempted. By this means a solution can be obtained to the continual nightmare of the research director—how to get the new product out of the test tube into commerce.

TRENDS IN RESEARCH

(*Continued from page 126*)

idly by during any revolution in the materials which they handle. We already have witnessed the commercial production of a cotton fabric which is not woven on looms but which is felted from a plastic-impregnated pulp in much the same fashion as paper is made. Also, we are hearing about experiments with fabrics containing just enough plastic fibers to make possible, let us say, a new method of making shirts—a method in which the sleeves are attached by a sort of welding in a way which may possibly be faster and cheaper than stitching. And, finally, we are seeing technology used as a means of defense as well as attack. We are seeing the application of modern chemistry to old fibers to keep them in the running with the new. Thus, the synthetic fibers of today will meet stiffer competition tomorrow as it becomes increasingly possible, by the proper treatment, to make cotton and wool fireproof or waterproof, greaseproof or creaseproof, and shrinkproof or runproof.

If we were to multiply the illustrations it would become apparent that plastics need by no means be an essential part of all composite materials in the future. We must not forget plywood, the non-ferrous alloys, and particularly aluminum, which has recently declined in price when almost everything else has risen. The principle of composite construction is already to be found in shipping cases of resin-bonded plywood lined with thin sheets of stainless steel, and in moisture-proof containers made of kraft paper, pliofilm, and aluminum foil laminated together. The number of such combinations is bound to grow because functional engineering represents the inevitable meeting ground of the maximum of performance with the minimum of cost.

Composite construction may be no answer to your particular problem, of course, and functional engineering may be less helpful to you than the older and more orthodox forms of engineering. But, whatever may be the means you choose to solve your project, be sure you choose the right project in the first instance. Be sure, in particular, that you choose one which promises to broaden the base of your business. Remember that corporate earnings can no more be perpetuated without new products than family names can be perpetuated without children.

ONE ANSWER: DIVERSIFICATION

In conclusion, therefore, here is the most important lesson to be learned from any research in research. It is the increasing necessity of business to diversify its products if it is to maintain its profits. In this new world of accelerating technological change no product of any company is immune to competition—competition either from similar products made by new and cheaper methods, or from quite dissimilar products serving the same purpose but in a better fashion. The profits from any single product will inevitably grow to a maximum and then be shrunken either by old age or by external attack. And only one effective answer is possible. It is the continuous recruiting of new products to replace the continuing casualties among the old.

To be sure, your profits may be high at the moment, and your business horizon may be free of clouds. Take heed, however, of the teachings of industrial history and recall how rare indeed has been stability in profits over any extended period. Recognize, if you will, that corporate earnings have two dimensions: not height alone, but area of base as well. And note that this principle, as stated in these simple architectural terms, has been amply confirmed by the experience of the ages. Thus, all the obelisks of ancient Egypt have long since fallen, but every pyramid still stands.

FROM THE VIEWPOINT OF THE EDITORS——

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WHAT IS SCARCE?

EVERYTHING is scarce, is almost a fair answer to this question. Certainly the vast majority of important primary chemicals are not available in quantities needed by our customers. Business generally would exceed any previous level if there were only enough goods to be used for manufacturing. And that would be true despite scarcity of competent and skilled labor wishing to work diligently even at high wages.

This scarcity problem is creating the need for a new type of chemical engineering diplomacy. It is making necessary a selective allocation by producers so that each customer fares as well as he can under present difficult circumstances. It is not surprising that one of the outstanding chemical sales managers of our industries recently wrote to all of his field staff stressing the necessity for frank and cooperative dealing with would-be purchasers.

Incidentally, that particular firm which admonished its salesmen to take constructive measures in curtailing the orders accepted to a very minimum, is one that is using a highly commendable basis for selecting certain of the orders which it will fill. In one important case that company is supplying one of its scarce chemical materials to a new customer simply because the newcomer is doing a constructive development job on the use of the chemical for novel applications which give promise of substantial public value when success is achieved. Thus the long-term public benefit as well as the equitable division of limited supplies among customers is being tested.

Apparently the customer industries are not always being quite as statesmanlike in their buying practice. At no previous time, not even during the war period, has there been occasion for more considerate treatment of suppliers. In a time when it is a seller's market, the buyer should not resort to subterfuge in order to increase the supply granted him of scarce materials. Consideration on both sides will make the present difficulties a little more bearable.

METHANOL vs. AMMONIA

AGAIN the competition is keen between methanol and ammonia for use of the factory capacity which is able to make either chemical product. And again there appear to be political considerations which outweigh the practical technical factors of real importance to the American public.

The Combined Food Board so insistently asked for more fertilizer materials, that Washington during June veered way over to the extreme in its effort to produce ammonium nitrate at wartime arsenals. This nitrogen fertilizer is intended both to fill out deficits in the United States and to supply large quantities for distribution by occupation forces of the Army in both Germany and Japan. The objective sought is a commendable one. But the methods selected imply a serious danger for next winter's anti-freeze supply of the United States.

Nothing should stand in the way of the programs which were previously projected to convert a reasonable amount of former Ordnance capacity over to the making of synthetic methanol. The deficiency in anti-freeze chemicals will be bad news even if all these programs go forward vigorously and without the restriction of fertilizer zealots.

Actually the Washington situation in July seems to put some millions of American automobiles in danger of freeze up next winter unless something is done to rationalize administrative handling of these so-called "surplus" plants.

BETTER GAS UTILIZATION

MANUFACTURING Chemists' Association has very wisely spotlighted one important fact regarding use of natural gas in the appearance of Warren N. Watson before Federal Power Commission this summer. It will be startling to most chemical engineers to realize how much more valuable natural gas is relatively when used for chemical manufacture than when applied as a fuel. That point of economic comparison was really the most persuasive one presented in Mr. Watson's excellent testimony urging that continuing supply of natural gas be assured for our industries.

If 10 million cubic feet a day of natural gas is burned as fuel, the value is only $730,000 per year if one assumes the gas is worth as much as 20 c. per M. If that same amount of hydrocarbon fuel is converted into chemicals, the value of the product is many times greater. Furthermore, a $25 million plant will be operating giving employment regularly to 1,500 men in order to make 200 million pounds per year of chemical products. The economic advantage to society is evident.

Chemical enterprise seldom makes a more substantial contribution to social progress than in cases like this. Chemical engineers generally should emphasize to public officials how this sort of process industry development works for the good of all.

AN INDEX OF PROGRESS

LABOR is now, more than ever before, an important element in the cost of all industrial goods, including the products of the chemical process industries. Every chemical engineer and executive knows this and undertakes to do something about it in his planning and administration.

An index of the progress which we are making in lowering labor as a factor in total cost is desirable. Such an index is found in the ratio between quantity of goods produced and number of man hours used, or in the ratio between total cost and direct labor cost for any specific

item. Application of such index in each individual plant or process is desirable.

Industry and agriculture can both find significant interest in comparisons of this sort recently calculated by Bureau of Agricultural Economics. The effect of war, the benefit of peacetime improvement, and the influence of depression are all shown in the charts of BAE. In both World War I and the Global War the labor cost per unit of product increased sharply. The advance between 1915 and 1920 or 1921 was 80 percent in agriculture and 200 percent in industry. Between wars there was a steady betterment of labor as an element of cost, so that the labor factor was much lower during the period 1930 to 1940. And the depth of the depression brought drops in labor cost even below that decade average.

Generalizations of this sort are interesting. But of greatest significance to chemical engineers is another much more specific comparison. That is the test as to whether we can make our technology improvement rapidly enough so that labor cost per unit of product will not go up even when wage rates advance sharply. That hoped-for result is a real test of chemical engineering achievement.

A SAWDUST HOUSE

Chemical enterprise is offering many new materials of construction for housing as well as for industry. Most of the proposals made by engineers or wisely informed industry are at least sound, if not operatively successful in the immediate future. But we are reluctant to use one which comes from one of the members of the United States Senate.

That distinguished gentleman, competent in politics or he'd not be in the Senate, proposes a new method of meeting the housing shortage which, frankly, we do not like. He thinks that all of the surplus wood wastes of the country can well be chewed up into sawdust, from which one then can make plastics, and thereby proceed to erect veterans' housing on a magnificent scale. Of course he hangs this achievement on "mass production of homes for veterans through utilization of wartime production techniques."

Chemical engineering has achieved a glamor which in this and in some other cases is more an embarrassment than an encouragement. We do not think that the Senator's bill will pass. And we wish that he and others would not attempt such extreme methods in support of what they think to be new chemical enterprise.

"THE FIRST OF 105"

A suit in the federal courts by the anti-trust division of the Department of Justice against a large chain store involves principles of substantial importance to all chemical process industries. It is the attempt to demonstrate that Great Atlantic & Pacific Tea Co. is proceeding with illegal marketing under the anti-trust laws because of factors which seem to result essentially from mere magnitude of business. This is stated to be the first of 105 merchandising cases which Justice plans to bring in the courts soon.

The savings effected by A & P through mass buying are passed on to the customers in the form of prices lower than those which most smaller firms can charge without loss. The government attorneys do not say that this is inherently illegal, it appears. But the contention seems to mean that mere bigness giving low prices to customers represents an unfair competition and, therefore, that the company must be prevented by the court from so effectively doing business.

It will be very interesting to all enterprise to find out whether the government in this case succeeds by court action in enforcing dissolution of a business or change in business methods merely because "no competitor can hope to remain long in business" while this firm does business efficiently. If the court supports the government plea, it appears that the judicial conclusion will be that "bigness is badness" intrinsically even though it contributes its benefits largely, if not wholly, to the public.

THE LEGISLATIVE JAM

It is likely that a great majority of the members of Congress would agree that careful legislation on the proposed Science Foundation, on control of atomic energy, on mineral stockpiles, and on a dozen other difficult and debatable subjects would have been good for America. One wonders how it is going to be possible for Congress to finish any of this legislation in its brief post-election period before the end of this Congress in December.

Perhaps engineers and industrial executives can help Congressmen a little in these matters. While the legislators are at home trying to grow votes "at the grass roots" it would be well to take every convenient occasion to help these non-technical men to understand the fundamental meaning of pending technical measures. Most Congressmen will welcome the factual presentation of information that bears on law-making which they must attend to next winter. In many cases pending bills have been delayed, or have even died, largely because the legislators are afraid of them because they do not understand them. One of the civic duties of engineers is, therefore, to take up these questions with their Congressman and Senators and see that they know the facts behind the bills when they go back to Washington next winter.

There may properly be added to that educational effort incidentally, a reasonable amount of propaganda for such bills as have significance for individual companies. But the individual company will fare best in future legislative attention if it first makes sure that the members of Congress understand technically what they are trying to do before the arguments pro or con are presented.

INTERNATIONAL MEETINGS IN PARIS

Wartorn France is slowly but surely recovering her former interest in the world chemical industry. In September two technical organizations will hold meetings in Paris with an international flavor. The International Technical Congress meets from September 16 to 21. It is being organized by an international committee for the purpose of establishing contact for the first time between engineers and technicians from all parts of the world. The Twentieth Congress of Industrial Chemistry sponsored by Societe de Chemie Industrielle meets from September 22 to 28. American chemists and engineers are cordially invited and urged to attend these important conferences.

REPORT ON.....

JAPANESE

Chemical Industry's Outlook

Between the end of actual fighting and the signing of the peace treaties, a great deal of study has been going forward so that the United States will not again be faced with a rearmed or militaristic Japan. Several valuable reports have been submitted. Among the reports recently released were those made by the U. S. Strategic Bombing Survey and by the National Engineers Committee of the Engineers Joint Council. Of particular interest to *Chem. & Met.* readers are the findings and recommendations in these reports which will affect the Japanese chemical industry.—*Editors*

One of the most necessary components of the modern war machine is a powerful chemical process industry. Recognizing this fact, our government directed several committees to study the Japanese industrial disarmament problem. The United States Strategic Bombing Survey recently released a report on its findings. It found in part that before the Manchurian Incident in 1931, Japan's industrial structure was fragile because of the absence of raw materials and the infancy of heavy industry. The chemical industry was undeveloped. The nation consumed small quantities of chemical products and many of these were imported from the United States, Germany or Great Britain.

The decade 1931 to 1941 was an era of rapid expansion. There was no organized five-year plan, but there was a combination of separate incentives. Self-sufficiency in food required vast tonnages of artificial fertilizer, and conquest on the continent multiplied orders from the Army and Navy. Laws were adopted favoring new enterprises and labor was cheap.

Earliest expansion occurred in production of synthetic ammonia and sulphuric acid for ammonium sulphate for fertilizers. As the decade wore on, emphasis was shifted to other products more directly connected with the visions which shimmered in the minds of the militarists. Nitric acid, toluene, methanol and explosive plants were built. Within ten years, the production rate was increased by the percentages which follow: calcium carbide 160 percent, sulphuric acid 225, ammonia 420, nitric acid 1,030, caustic soda 1,080, toluol 1,360, explosives 1,890, and methanol 21,500. By 1941 there were approximately 600 chemical plants employing more than 300,000 people.

When the war came the chemical industry in Japan was small by our prewar standards. Based on a production rate in the United States equal to 100, the corresponding figures for war-primed Japan were: benzol and toluol 6, methanol 11, caustic soda 21, nitric acid 28, organic military high explosives 36, calcium superphosphate 42. An exceptional case was the manufacture of ammonium sulphate (and the two raw materials for it, ammonia and sulphuric acid) which was carried on in Japan on a very large scale. The impressive development of this industry was favored by the need of the chemical as a fertilizer and the availability of abundant cheap electric power, manpower, coal, pyrites, water and air, all of which are consumed in its production. The relative production rates for ammonium

JAPANESE PRODUCTION RATES OF IMPORTANT CHEMICALS IN 1946

Metric Tons

	February 1946	March 1946	April* 1946	Requirements Met in March
Sulphuric acid	44,030	56,562	71,000	18%
Ammonium sulphate	21,908	28,908	36,000	23%
Salt	12,457	15,832	18,000	17%
Calcium cyanamide	9,772	11,450	16,000	31%
Calcium carbide	7,405	10,325	13,000	31%
Ammonia	7,023	9,592	13,000	31%
Calcium superphosphate	2,199	3,404	12,000	27%
Soda ash	1,248	2,716	5,300	37%
Caustic soda	1,727	2,187	3,700	24%
Hydrochloric acid	540	1,085	1,800	17%
Nitric acid	....	723	1,000	8%
Benzene	198	352	800	34%
Methyl alcohol	230	214	600	10%
Ethyl alcohol (kiloliters)	1,708	1,268	1,800	25%
Sodium bicarbonate	160	337	200	51%
Dyestuffs	51	58	1,800	9%
Chlorine	13,600†	....	....	†15%
Toluene	144†	....	....	†5%

*Estimated production rates for April are based on Japanese estimates submitted to Headquarters of The Supreme Commander For The Allied Powers. †Estimated December 1945 production rates.

sulphate, ammonia, and sulphuric acid are 185, 76, and 37, impressive figures particularly if put on a per capita basis.

In 1942 the government adopted integrated plans for expansion of the production of nitric acid and organic chemicals. A high priority was accorded nitric acid as a direct consequences of its importance in the manufacture of explosives. This was expected to quadruple the production rate in four years. Of this broad plan not even the portion scheduled for 1943 was accomplished. Two of three projected stages were completed. In 1945 the Japanese were still working on the 1943 program. Actual production never reached more than half of expectation in spite of the attractive program of subsidies and tax exemptions. The expansion program for organic chemicals was likewise boosted by tax exemptions, tariff privileges and subsidies.

SYNTHETIC METHANOL

The volume of synthetic methanol also reached its peak of 785,000 gal. per month in March 1944. The importance of methanol to Japan at war can scarcely be overestimated. It was required in synthetic plastics of the methacrylate and formaldehyde types, in explosives, and as a liquid fuel. The methanol plants were generally well operated, possibly as a consequence of the similarity of the process to ammonia, which the Japanese understood from long experience. Because of the critical need for methanol, an ammonia plant was converted to one for the production of methanol in 1944. Almost immediately after the conversion, the shortage in coke forced a severe curtailment of production.

Japan's chemical products can be classified into two general categories, (1) chemicals directly used for war and (2) basic chemicals used for war or peace. The first includes nitric acid, explosives, benzol, toluol, methanol, transparent plastics and tetraethyl lead. The second includes ammonia, calcium carbide, caustic soda, sulphuric acid and chlorine. For all the war chemicals, production rose steadily from 1941 until the first quarter of 1944, and then declined rapidly. It should be noted that the decline began before the B-29's started operations. For the basic chemicals of the second group, declines in production had started early in 1941.

Caustic soda was the only chemical shortage which proved to be a direct hindrance to the war effort. It was used for synthetic fibers, explosives and aluminum. Although four out of five rayon plants were shut down in 1941 as conservation measures, there was not sufficient caustic soda for the refining of available bauxite.

In 1941 when most sulphuric acid went into the manufacture of ammonium sulphate, the Japanese produced more than one and one-half times the quantity of ammonium sulphate made in the United States. As ammonia supplies for fertilizers were cut down, sulphuric acid production was curtailed. As the output of rayon decreased, more sulphuric acid capacity became surplus. No new plants were built during the war and many of the 83 dispersed throughout the islands rusted in idleness. From the 1937 peak of 208,917 tons per month the rate had declined to a mere 12,000 tons by August 1945.

The major portion of the chemical industry in Japan is incorporated in large integrated industrial complexes, many of them in urban areas. It was, therefore, possible to inspect a considerable portion of the total production capacity by visiting relatively few plants. A total of 44 plants were inspected, most of them in the large chemical centers in the western part of the home islands. A detailed inspection was made in 19 of the most heavily damaged chemical plants by members of the U. S. Strategic Bombing Survey.

The plants visited were found to have suffered a loss of $46,000,000, about 22 percent of their total investment. Estimates were made on the basis of comparative American costs of labor, material, and construction methods. It is estimated that the entire chemical industry was damaged to the extent of less than $100,000,000, which is probably about 5 percent of the investment in the whole home islands chemical industry.

Fire damage accounted for 45 percent of total bombing losses to the chemical industry. Plants producing various organics, explosives, and coke byproducts were particularly vulnerable because of the presence of considerable stocks of flammable materials in process and in storage. Fire was not effective against chemical plants producing such non-flammable products as sulphuric acid, soda ash, caustic soda, and ammonium sulphate.

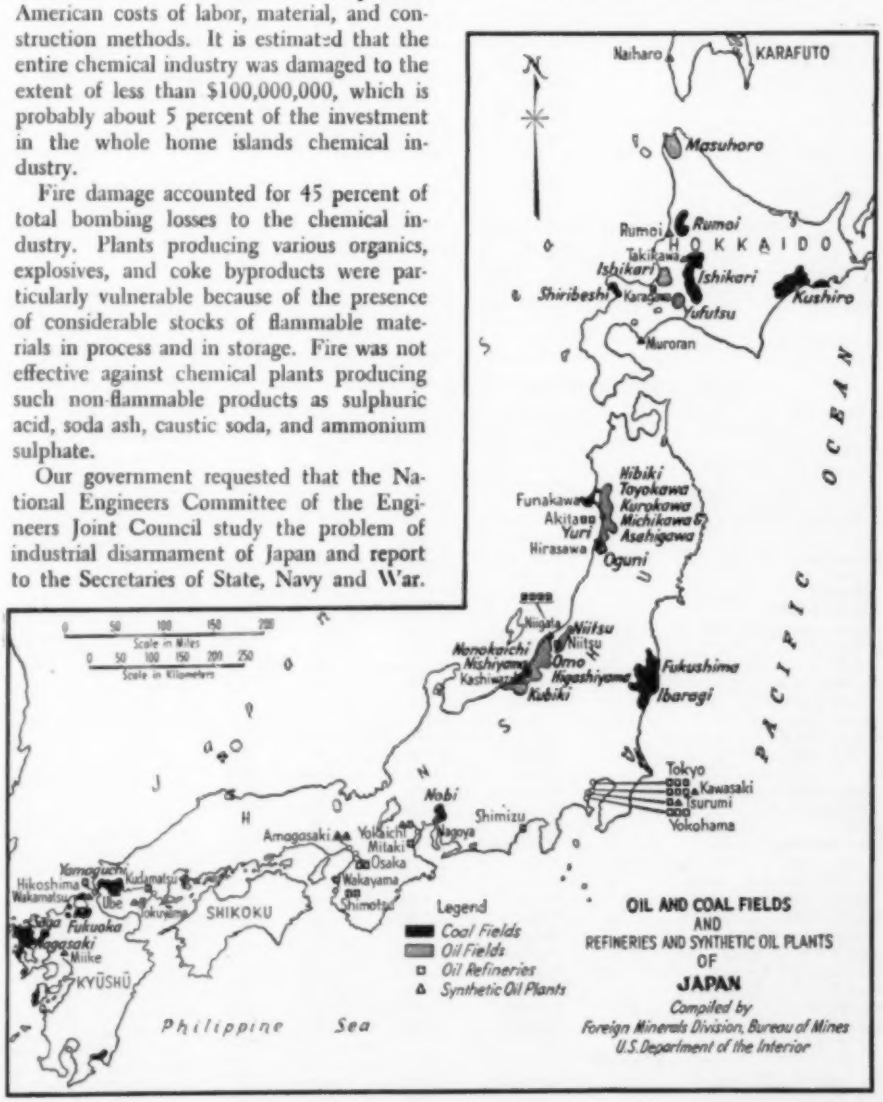
Our government requested that the National Engineers Committee of the Engineers Joint Council study the problem of industrial disarmament of Japan and report to the Secretaries of State, Navy and War.

The committee reporting on industrial disarmament of Japan was composed of H. Foster Bain, Charles W. E. Clark, Sidney D. Kirkpatrick, Harry S. Rodgers, R. E. Zimmerman, and Carlton S. Proctor, chairman.

COMMITTEE FINDINGS

This committee found that Japan, like her axis partners, built much of her war program around her heavy chemical industries. In the three years from 1934 to 1937 chemical output was increased by more than 50 percent in annual value—from 851 million yen ($238,800,000) to 1,424,594,000 yen ($400,000,000). Much of this and subsequent expansion during the war was in the nitrogen, sulphuric acid and calcium carbide industries, which contributed directly to war production and which, therefore, must be considered as key commodities in any program of industrial disarmament.

Nitrogen is of most vital importance to the Japanese economy both in peace and in war. Ability to meet the food requirements



of her large population depends primarily upon chemical fertilizers, particularly nitrogen. At the same time, nitrogen is the basic element of all military explosives with the exception of the atomic bomb. Because of this two-fold dependence, the Japanese built a large synthetic ammonia industry that had an estimated capacity in 1944 in excess of 450,000 metric tons of nitrogen, exceeded only by Germany and the United States.

NITROGEN

To eliminate war potential without unduly crippling the output of fertilizers needed for essential food production, it is recommended by the National Engineers Committee that:

1. The synthetic nitrogen production of postwar Japan be limited to 180,000 metric tons of nitrogen per year of which 90,000 tons shall be produced as calcium cyanamide and the remainder supplied by synthetic ammonia plants, preferably those using hydroelectric power for the production of the necessary hydrogen.

2. All production capacity for nitrogen fixation as synthetic ammonia in excess of 90,000 metric tons be eliminated by destruction or removal. Related equipment suitable for hydrogenation of coal, oil or other organic materials for the production of alcohols, synthetic fuels, etc. should likewise be eliminated.

3. Japanese citizens and nationals, corporations or the Japanese government or any agents thereof, be prevented from obtaining complete or partial control of any financial interests in any nitrogen fixation plant in any other countries.

4. Synthetic ammonia and related high-pressure plants all require heavy steel and alloy forgings as essential parts of their equipment. The same steel mills that produce these heavy forgings and castings produce armament, heavy artillery pieces, gun carriages, etc. If the iron and steel industry were prevented from the use of such facili-

JAPANESE INDUSTRIAL CHEMICAL PLANT CAPACITIES (In Metric Tons Per Year)

Name	Location	Capacity Before Damage	Capacity After Damage
NITRIC ACID			
umitomo Kagaku (Niihama)	Ehime	25,900	16,820
oyo Koatsu (Omuta)	Fukuoka	20,400	10,800
ihon Chissо (Minamata)	Kumamoto	16,800	10,200
issan Kagaku (Toyama)	Toyama	10,400	10,400
howa Denko (Kawasaki)	Kanagawa	7,600	0
owa Gosei (Nagoya)	Aichi	4,800	1,200
be Kosan (Ube)	Yamaguchi	7,600	3,600
itsubishi Kasei (Kurozaki)	Fukuoka	5,200	3,600
itchitsu Kagaku (Nobeoka)	Miyazaki	12,800	8,000
itsui Kagaku (Miike)	Fukuoka	6,400	2,400
CAUSTIC SODA, Process Not Reported			
agye K.K.	Kyushu	90,000	36,000
okuyama Soda K.K.	Tokuyama	82,800	36,000
	Yamaguchi	95,000	25,900
oyo Soda Kogyo K.K.	Tokuyama	57,600	27,000
	Yamaguchi	103,000	19,100
Ube Soda Kogyo K.K.	Osaka	23,725	23,725
	Yamaguchi	51,550	19,100
ELECTROLYTIC CAUSTIC SODA			
eikoku Magnesium K.K.	Yamagata	11,520	10,080
akkosha K.K.	Yamagata	3,600	3,000
howa Denko K.K.	Fukushima	1,080	960
odogaya Kagaku Kogyo K.K.	Fukushima	2,160	2,160
uroha Kagaku Kogyo K.K.	Fukushima	12,600	4,800
issan Kagaku Kogyo K.K.	Tokyo	9,360	3,000
oi Nihon Kagaku Kogyo K.K.	Kanagawa	7,920	3,000
howa Denko K.K.	Kanagawa	6,120	4,320
odogaya Kagaku Kogyo K.K.	Kanagawa	3,360	800
surumi Soda K.K.	Kanagawa	5,040	2,160
anto Denko Kogyo K.K.	Gumma	11,800	10,650
sahi Denko Kogyo K.K.	Tokyo	16,200	14,400
anagafuchi Kaisui Riyo Kogyo K.K.	Kanagawa	1,320	480
ippon Soda K.K.	Niigata	36,000	19,200
ippon Soda K.K.	Toyama	6,480	3,240
issan Kagaku Kogyo K.K.	Toyama	288	144
oa Gosei Kagaku Kogyo K.K.	Toyama	10,800	6,480
oa Gosei Kagaku Kogyo K.K.	Aichi	10,800	6,000
itsubishi Kasei Kogyo K.K.	Osaka	1,440	1,200
aniwa Gosei Kako K.K.	Osaka	2,880	2,580
oa Koko K.K.	Osaka	5,040	960
oa Kagaku Kogyo Go.K.	Osaka	600	600
ura Kagaku Kogyo K.K.	Hyogo	2,880	0
saka Soda K.K.	Hyogo	6,120	0
.K. Nakayama Seikosho	Wakayama	2,880	2,520
anagafuchi Kogyo K.K.	Hyogo	3,120	2,880
oa Gosei Kagaku Kogyo K.K.	Kagawa	9,000	6,120
Sumitomo Kagaku Kogyo K.K.	Ehime	900	480
.K. Nakayama Seikosho	Ehime	1,200	0
Sumitomo Kagaku Kogyo K.K.	Okayama	900	240
oyo Soda Kogyo K.K.	Yamaguchi	1,920	1,800
Mitsubishi Kasei Kogyo K.K.	Fukuoka	7,200	1,800
saka Soda K.K.	Fukuoka	10,080	7,200
Mitsui Kagaku Kogyo K.K.	Fukuoka	19,080	12,000
Nitchitsu Kagaku Kogyo K.K.	Miyazaki	18,720	9,720
BUTANOL			
Godoshussei Co. Ltd. (Asahikawa)	Hokkaido	3,400	3,400
Tohoku Alcohol Co. Ltd. (Hachinoe)	Aomori	800	600
Kosei Co. Ltd.	Osaka	400	400
GLYCEROL			
Nisan Chem. Ind. Co. Ltd. (Honshu)	Osaka	1,050	1,050
Dai Nippon Oils Co. Ltd.	Tokyo	1,020	0
Miyoshi Chemical Ind. Co. Ltd. (Azuma)	Tokyo	600	0

Name	Location	Capacity Before Damage	Capacity After Damage
GLYCEROL (Continued)			
Marumiya Shop (Mukosima)	Tokyo	240	0
Shisedo Co. Ltd. (Mukosima)	Tokyo	240	240
Dai Ichi Oils Chem. Ind. Co. Ltd.	Tokyo	108	0
Partnership Hasshiya	Tokyo	216	0
Nihon Soda Co. Ltd. (Nihongi)	Niigata	210	210
Nissan Kagaku Kogyo K.K. (Tsukuda)	Osaka	2,500	2,500
Nissan Kagaku Kogyo K.K. (Oji)	Tokyo	1,500	1,500
Asahi Denka Kogyo K.K. (Ogu)	Tokyo	1,300	1,300
Lion Oil & Fats Co. Ltd. (Hirai)	Tokyo	2,100	0
Dai Ichi Seiyaku Co. Ltd. (Osaka)	Osaka	1,200	1,200
Kanegafuchi Oils Co. Ltd. (Fukimi)	Kyoto	750	750
Nihon Kayaku Seizou Co. Ltd. (Aso)	Yamaguchi	600	600
Nika Oils Co. Ltd. (Kokura)	Fukuoka	600	600
SYNTHETIC AMMONIA			
Towa Gosei (Nagoya)	Aichi	15,600	5,400
Mitsubishi Kasei (Kurozaki)	Fukuoka	18,000	18,000
Toyo Koatsu (Hikoshima)	Yamaguchi	3,600	3,600
Nihon Hiryo (Minamata)	Kumamoto	9,600	3,600
Nitchitsu Kagaku (Nobeoka)	Miyazaki	13,200	3,600
Nitto Kagaku (Hachinohe)	Aomori	13,200	3,600
Nitto Kagaku (Yokohama)	Kanagawa	4,800	4,800
Tohoku Hiryo (Akita)	Akita	8,600	8,600
Toyo Gosei (Niigata)	Niigata	1,200	1,200
Sumitomo Tagi (Befu)	Hyogo	7,800	3,400
Toyo Koatsu (Omuta)	Fukuoka	60,000	12,000
Showa Denko (Kawasaki)	Kanagawa	57,600	4,200
Sumitomo Kagaku (Niihama)	Ehime	48,000	36,000
Ube Kosan (Ube)	Yamaguchi	42,000	8,400
Nissan Kagaku (Toyama)	Toyama	36,000	36,000
CALCIUM CARBIDE			
Tekkosho K.K. (Sakata)	Akita	5,000	4,000
Tohoku Denki Seitetsu K.K. (Wakagawa)	Iwate	3,000	1,500
Morioka Denka Kogyo K.K. (Iwanebashi)	Iwate	1,000	1,000
Nagai Kagaku Kogyo K.K. (Iidagawa)	Akita	2,000	2,000
Kano Kozan Ganka Sekkai Kojo (Honsho)	Fukushima	400	400
Fukuden Kogyo K.K. (Nakase)	Fukushima	500	500
Dai Nihon Celloid K. K. (Arai)	Niigata	20,000	20,000
Hokuyetsu Denka Kogyo K.K.			
(Zao)	Niigata	10,000	8,000
(Dooi)	Niigata	2,100	0
Showa Denko (Kanose)	Niigata	50,000	50,000
Denki Kagaku Kogyo (Asmi)	Niigata	66,000	66,000
Shinetsu Kagaku Kogyo (Naoetsu)	Niigata	45,00	45,000
Nihon Kabaido Kogyo (Uozo)	Toyama	41,000	41,000
Ibigawa Denki Kogyo (Nishiogaki)	Gifu	22,000	22,000
Denki Kagaku Kogyo (Omuta)	Fukuoka	40,000	0
Niigata Denki Kogyo K.K. (Nuttare)	Niigata	4,000	3,000
Chuyetsu Denki Kogyo K.K. (Namerikawa)	Toyama	10,000	8,000
Taihoku Kogyo K.K. (Nanoichi)	Ishikawa	4,000	3,500
Osaka Denka Kogyo K.K. (Tsuruki)	Ishikawa	1,000	800
Ibigawa Denki Kogyo K.K. (Ogaki)	Gifu	25,000	24,000
Daido Kagaku Kogyo K.K. (Takefu)	Fukui	15,000	10,000
Tosa Denka Kogyo K.K. (Hagimachi)	Kochi	4,500	3,500
Asano Cement K.K. (Tosa)	Kochi	500	300
Nihon Chisso Hiryo K.K. (Minamata)	Kumamoto	30,000	26,000
Nihon Gosei Kagaku Kogyo K.K. (Kumamoto)	Kumamoto	18,000	12,000
Nihon Kogyo K.K. (Kagami)	Kumamoto	10,000	5,500
Kyushu Denki Kogyo K.K. (Hinode)	Oita	1,500	1,300
CRUDE NAPHTHALENE			
Nippon Seitetsu K.K.			
(Yawata)	Fukuoka	8,910	7,080
(Hirohata)	Hyogo	2,460	2,460
(Kamaishi)	Iwate	2,000	510
(Wanishi)	Hokkaido	6,640	6,640

ties, it would be difficult or impossible to rebuild the synthetic ammonia, alcohol and fuel plants.

SULPHURIC ACID

Prior to the war about 60 percent of the sulphuric acid produced in Japan was required to manufacture ammonium sulphate and superphosphate. Since the output of neither of these essential fertilizers will likely be curtailed, it is estimated that at least 2 million tons of 50-deg. acid will be required for these vital uses. Other uses will require about 750,000 tons so that a maximum output of about 2,750,000 tons from a total plant capacity of 3,000,000 tons of 50-deg. acid (1,865,000 tons of 100 percent acid) should be adequate. It is therefore, recommended that:

1. The Japanese capacity for the production of sulphuric acid in excess of 3,000,000 tons per year of 50-deg. acid should be eliminated, first at all military arsenals and explosives plants, and second, at those poorly located to serve peacetime industries.

2. The manufacture of the permitted quantity of acid be by the contact rather than by the older chamber process for the following reasons: (a) Contact acid produces a better grade of ammonium sulphate; (b) chamber operation requires the consumption of a certain amount of ammonia which will be needed for the fertilizer program; (c) Contact plants, if damaged, can be put back into operation without the extensive use of sheet lead or skilled lead burners required for chamber process plants.

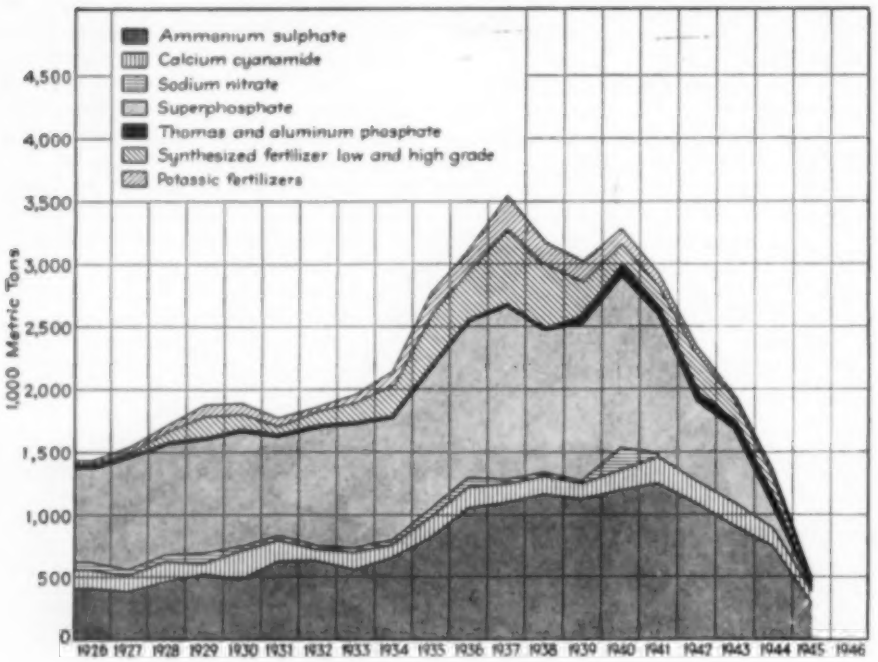
3. Production of oleum and fuming sulphuric acid should be eliminated as a war hazard, or if found essential for certain restricted uses, its manufacture should be licensed, but all existing capacity should be dismantled or destroyed.

4. Since sufficient raw materials are readily available within Japan proper in the form of pyrite, crude sulphur, zinc blende, sulphide copper ores, etc., it will not be

JAPANESE INDUSTRIAL CHEMICAL PLANT CAPACITIES (In Metric Tons Per Year)

Name	Location	Capacity Before Damage	Capacity After Damage
CRUDE NAPHTHALENE (Continued)			
Nippon Kokan K.K. (Kawasaki)	Kanagawa	1,420	0
Nakayama Seikosho K.K. (Okajima)	Osaka	1,810	1,810
Mitsui Kagaku Kogyo K.K. (Miike)	Fukuoka	1,980	980
Mitsubishi Kasei Kogyo K.K. (Kurosaki)	Fukuoka	2,120	1,180
Sumitomo Kagaku Kogyo K.K. (Niihama)	Yehime	450	450
Tokyo Gas K.K. (Oshima)	Tokyo	720	720
Hiroshima Gas K.K. (Aga)	Hiroshima	360	70
Osaka Gas K.K.			
(Torishima)	Osaka	1,820	450
(Nichi)	Hyogo	180	150
Toho Gas K.K. (Nagoya)	Aichi	710	170
Nippon Jinzo Sekiyu K.K. (Takigawa)	Hokkaido	700	600
BENZENE			
Nippon Seitetsu K.K.			
(Yawata)	Fukuoka	15,110	10,195
(Hirohata)	Hyogo	5,690	4,210
(Kamaishi)	Iwate	1,860	590
(Wanishi)	Hokkaido	2,440	1,850
Nippon Kokan K.K. (Kawasaki)	Kanagawa	4,560	1,810
Nakayama Seikosho K.K. (Funamachi)	Osaka	2,300	0
Mitsui Kagaku Kogyo K.K. (Miike)	Fukuoka	4,700	2,950
Mitsubishi Kasei Kogyo K.K. (Kurosaki)	Fukuoka	2,420	1,950
Sumitomo Kagaku Kogyo K.K. (Niihama)	Yehime	520	290
Tokyo Gas K.K. (Yokohama)	Kanagawa	720	65
Osaka Gas K.K.			
(Iwasakimachi)	Osaka	700	0
(Torishima)	Osaka	900	360
Toho Gas K.K. (Nagoya)	Aichi	10	0
Kokoku Kagaku Kogyo K.K. (Amagasaki)	Hyogo	610	0
TOLUENE			
Nippon Seitetsu K.K.			
(Yawata)	Fukuoka	4,130	2,640
(Hirohata)	Hyogo	1,460	1,050
(Kamaichi)	Iwate	280	100
(Wanishi)	Hokkaido	970	390
Nippon Kokan K.K. (Kawasaki)	Kanagawa	1,150	315
Nakayama Seikosho K.K. (Funamachi)	Osaka	510	0
Mitsui Kagaku Kogyo K.K. (Miike)	Fukuoka	1,850	630
Mitsubishi Kasei Kogyo K.K. (Kurosaki)	Fukuoka	220	195
Sumitomo Kagaku Kogyo K.K. (Niihama)	Yehime	160	85
Tokyo Gas K.K. (Yokohama)	Kanagawa	180	30
Osaka Gas K.K.			
(Iwasakimachi)	Osaka	60	0
(Torishima)	Osaka	60	20
Toho Gas K.K. (Nagoya)	Aichi	5	0
Kokoku Kagaku Kogyo K.K. (Amagasaki)	Hyogo	100	0
SULPHURIC ACID, Process Not Reported			
Sumitomo Kagaku (Niihama)	Ehime	234,000	234,000
Toyo Kyatsu (Omuta)	Fukuoka	129,600	108,000
Mitsubishi Kasei (Kuroski)	Fukuoka	43,200	43,200
Ube Kosan (Ube)	Yamaguchi	108,000	43,200
SULPHURIC ACID CONTACT PROCESS			
Nippon Seitetsu K.K. (Wanishi)	Hokkaido	25,185	25,185
Toyokoatsu Kogyo K.K. (Sunabawa)	Hokkaido	131,400	131,400
Nitto Kagaku Kogyo K.K. (Hachinoye)	Aomori	36,500	36,500
Tohoku Hiryo K.K. (Akita)	Akita	43,800	43,800
Nitto Kokogyo K.K. (Fukuyama)	Fukushima	18,250	0

Name	Location	Capacity Before Damage	Capacity After Damage
SULPHURIC ACID CONTACT PROCESS (Continued)			
Nippon Suiso Kogyo K.K. (Onahama)	Fukushima	87,600	78,600
Nippon Kogyo K.K. (Nidachi)	Ibaragi	36,500	36,500
Niigata Ryusan K.K. (Ishiyma)	Niigata	18,250	18,250
Nissan Kagaku Kogyo K.K. (Toyama)	Toyama	18,250	18,250
Nippon Soda K.K. (Takaoka)	Toyama	3,650	3,650
Nissan Kagaku Kogyo K.K. (Oji)	Tokyo	18,250	18,250
Nitto Kagaku Kogyo K.K. (Nakagawa)	Tokyo	18,250	18,250
Nippon Kagaku Kogyo K.K. (Daini)	Tokyo	18,250	18,250
Hodogaya Kagaku Kogyo K.K. (Oshima)	Tokyo	10,950	10,950
Showa Denko K.K.			
(Kawasaki)	Kanagawa	54,750	54,750
(Yokohama)	Kanagawa	18,250	18,250
Hodogaya Kagaku Kogyo K.K. (Tsurumi)	Kanagawa	10,950	10,950
Nissan Kagaku Kogyo K.K. (Nagoya)	Aichi	18,250	18,250
Toa Gosei Kagaku Kogyo K.K. (Nagoya)	Aichi	73,000	73,000
Ishihara Sangyo K.K. (Yokkaichi)	Miye	87,600	87,600
Mitsui Kozan K.K. (Kamioka)	Gifu	32,850	32,850
Toga Layon K.K. (Shiga)	Shiga	18,250	18,250
Teikoku Kako K.K.			
(Osaka)	Osaka	18,250	18,250
(Owada)	Osaka	23,725	23,725
Sumitomo Kagaku Kogyo K.K. (Osaka)	Osaka	7,665	0
Kansai Ryusan (Amagasaki)	Hyogo	36,500	36,500
Nippon Jukagaku Kogyo K.K. (Amagasaki)	Hyogo	10,950	10,950
Kanoshima Jinzo Hiryo K.K. (Amagasaki)	Hyogo	36,500	36,500
Sumitomo Taki Kagaku Kogyo K.K.	Hyogo	36,500	36,500
Nippon Seitetsu K.K. (Hirohata)	Hyogo	18,250	18,250
Kanoshima Kagaku Kogyo K.K. (Kanoshima)	Okayama	54,750	54,750
Mitsui Kozan K.K.			
(Hibi)	Okayama	36,500	36,500
(Hikoshima)	Yamaguchi	32,850	32,850
Titan Kogyo K.K. (Ube)	Yamaguchi	18,250	0
Mitsui Kozan K.K. (Miike)	Fukuoka	32,850	32,850
Mitsui Kagaku Kogyo K.K. (Miike)	Fukuoka	21,900	21,900
SULPHURIC ACID CHAMBER PROCESS			
Nissan Kagaku Kogyo K.K. (Hakodate)	Hokkaido	16,425	16,425
Toa Koko K.K. (Miyako)	Iwate	43,800	43,800
Nippon Seitetsu K.K. (Kamaishi)	Iwate	17,775	17,775
Nitto Hiryo K.K. (Shiogama)	Miyagi	43,800	43,800
Nippon Soda K.K. (Aizu)	Fukushima	21,900	21,900
Kureha Kagaku Kogyo K.K. (Nishiki)	Fukushima	36,500	36,500
Nitto Ryuso K.K. (Niigata)	Niigata	36,500	36,500
Niigata Ryusan K.K. (Niigata)	Niigata	51,100	51,100
Denki Kagaku Kogyo K.K. (Omi)	Niigata	17,775	17,775
Nissan Kagaku Kogyo K.K.			
(Toyama)	Toyama	138,700	138,700
(Fushiki)	Toyama	40,150	40,150
(Ozi)	Tokyo	146,000	146,000
(Komatsugawa)	Tokyo	76,650	43,800
Nitto Ryuso K.K. (Tokyo)	Tokyo	40,150	0
Nitto Kagaku Kogyo K.K. (Nakagawa)	Tokyo	109,500	36,500
Nihon Kokan K.K. (Koyasu)	Kanagawa	37,850	32,850
Sowa Denko K.K. (Kawasaki)	Kanagawa	219,000	109,500
Nitto Kagaku Kogyo K.K. (Yokohama)	Kanagawa	94,900	94,900
Nissan Kagaku Kogyo K.K. (Nagoya)	Aichi	29,200	29,200
Toa Gosei Kagaku Kogyo K.K. (Nagoya)	Aichi	43,800	43,800
Ishihara Sangyo K.K. (Yokkaichi)	Mie	43,800	43,800
Toyo Reiyon K.K. (Shiga)	Shiga	29,200	29,200
Teikoku Koko K.K. (Osaka)	Osaka	32,850	32,850
Furukawa Kogyo K.K. (Osaka)	Osaka	42,705	42,705
Toa Koko K.K. (Osaka)	Osaka	92,345	74,095
Nanlwa Gosei Koko K.K. (Kizugawa)	Osaka	14,600	14,600
Nihon Kagaku Kogyo K.K. (Nishiyodogawa)	Osaka	18,250	18,250
Mitsubushi Kasei K.K. (Yodogawa)	Osaka	10,950	10,950



Consumption of Inorganic Commercial Fertilizers in Japan

necessary to control the production of these materials insofar as they are used in sulphuric acid manufacture.

CALCIUM CARBIDE

Calcium carbide is of vital importance to the national economy of Japan. Its largest single use is in the form of the derivative, calcium cyanamide, required for nitrogen fertilizers to increase the supply of home-grown foods. Next in importance are the uses of carbide for lighting homes, mines, and fisheries, to generate acetylene for the welding and cutting of iron and steel and the handicraft industries that fabricate all metal articles. Finally, and of growing importance in Japan as in Germany, is the use of acetylene for the manufacture of acetic acid for the food and chemical industries and for the production of other organic chemicals.

The following measures and methods of control are recommended by the National Engineers Committee:

1. That the Japanese calcium carbide industry be limited to an aggregate capacity to produce yearly 360,000 metric tons from supplies of electric power from time to time available, and in each year to produce no more than that amount.

2. That the Japanese calcium cyanamide industry be permitted an aggregate capacity to produce yearly 80,000 metric tons of contained nitrogen in form thereof, and in each year to produce up to that amount of contained nitrogen from permitted capacity of 90,000 metric tons.

3. That a calcium carbide-calcium cyanamide control commission be established and authorized from time to time to inspect all plants in Japan wherein calcium carbide, calcium cyanamide or both may hereafter be made, to control the operation of such plants to the extent necessary to limit their outputs of calcium carbide and cyanamide to the yearly aggregate amounts provided for above and, by license, to control the manufacture, distributions, sale, exportation and importation of such outputs.

Excluding low temperature carbonization, the total theoretical capacity of synthetic oil processes on the Japanese Islands is about 140,000 tons of primary product. Apparently the actual production fell far short of this amount.

It is recommended by the committee that synthetic oil plants operating on the hydrogenation or gas synthesis (Fischer-Tropsch) process be destroyed and that the Japanese be forbidden to work on these processes or their development. The retention of any such plants or continued Japanese work on or development of such processes would constitute a definite war potential because:

(a) They are primarily plants for the special production of a most important munition of war which puts them in the same class as plants for the production of explosives.

(b) The Japanese synthetic oil industry has been maintained through subsidy as an implement of war. This industry should be eliminated, not only as a source of supply of material essential to mechanized and air warfare, but because the equipment of this industry can, with certain modifications, be converted to the production of fixed nitrogen.

(c) Processes for the production of synthetic fuels require much heavy equipment and a large investment per unit of capacity, but employ a negligibly small labor force.

Low-temperature carbonization plants may be permitted because without hydrogenation or Fischer-Tropsch plants, only small amounts of motor fuel or fuel oil can be realized as byproducts of such plants. Their primary product would be low-temperature coke which is useful for domestic heating.

CONCLUSIONS

The Report on Industrial Disarmament of Japan concluded that if the Control Council in Japan will institute and maintain effective controls of power production and distribution, and industrial plant construction to

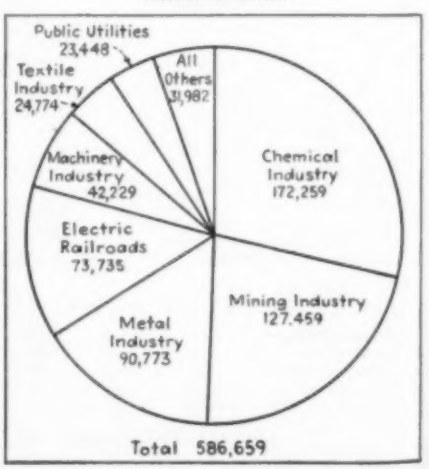
1. Prohibit the production of synthetic liquid fuels;
2. Prohibit the production of aluminum and magnesium;
3. Prohibit the use of nuclear energy;
4. Limit and control the synthetic fixation of nitrogen;
5. Limit and control the production of sulphuric acid and calcium carbide;
6. Limit and control the capacities and production of steel and steel products plants; and
7. Limit the capacities and production of copper such procedures will establish a considerable measure of assurance against the danger of Japanese rearmament.

These recommended procedures are not intended as a substitute for the protection afforded by an adequate police force of the United Nations in Japan.

For the guidance and direction of the policing forces there should be established a group of technological specialists who will keep informed as to Japanese industrial and research activities.

The tables and graphs showing the status of the Japanese chemical industry were compiled by the headquarters of the Supreme Commander for the Allied Powers.

Japan's contract electric power demand for January 1946 in thousands of kwh.



How To Determine Economical Batch Sizes

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Chemical industries that manufacture specialties, where the same equipment may be used for batches of different materials, are faced with the recurrent problem of deciding when to change from one run to another. This is an economic problem, determined by the relative costs of changeover and of holding materials in inventory. As the author shows, it can be readily solved when the problem is understood.—*Editors*

A CHEMICAL ENGINEER concerned with the various small batch processes using relatively expensive raw materials is faced with the problem of how to estimate the most economical size of a batch to be manufactured at one time. A solution to the problem is presented here. Since the same equipment is in many cases used for several different materials, there are two fundamental factors to be considered. They are the cost of job change and the cost of investment in inventory.

The job change cost may be quite high, whether it is cleaning of stills, kettles or other manufacturing equipment, or changing a straight-line production table with the necessary adjustments of the filling machine, capper, labeller and cartoner. Since this cost of job change is high, the production engineer may want to run as large a batch as is possible. However, he is also faced with the problem of increasing the amount of money invested in inventory as the size of the batch increases beyond the supply of material currently needed.

To see how these two different costs are related to another we will consider the factors involved.

UNIT COSTS

The unit cost for the job change is:

$$y_1 = \frac{b}{x} \qquad (1)$$

where y_1 is the unit of cost of job change, **b** is the job change cost in dollars, and x equals the number of units to be manufactured.

The unit cost of investment in inventory is:

$$y_2 = \frac{x}{a} \times \frac{c}{300} \qquad (2)$$

where y_2 is the unit cost of investment, **a** is the sales per month in pounds for bulk sales, or in number of units of packaged goods, **c** is the unit product cost.

There is one thing to look out for. If the raw materials are purchased especially for the job, the cost of these should be included in **c**. Raw materials regularly on hand should not be included in **c** for the purposes of Equation (2) in cases where they are also used for other items or bought in large quantities to obtain price discounts, since this investment exists whether they are processed or not.

Equation (2) is derived by letting x/a represent the number of months the lot will last. Figuring 4 percent per annum for investment on materials, the charge per month is:

$$c \times 4/100 \times 1/12 = c/300 \qquad (3)$$

Showing equations (1) and (2) graphically, it will be seen in Fig. 1 that the curve representing y_1 is parabolic, while y_2 is represented by a straight line. Let us now consider the curve representing $y_1 + y_2$. The minimum for this curve, which is the point in which we are interested, will be seen to be at $y_1 = y_2$. In other words, we have

$$\frac{b}{x} = \frac{x}{a} \times \frac{c}{300} \qquad (4)$$

which makes

$$x = 10\sqrt{\frac{3ab}{c}} \qquad (5)$$

There is no intention to claim that this formula is absolutely right. There are, in fact, plenty of vulnerable spots in the proof. Such an item as storage space has not been considered. Also, if the product is sold immediately after it is manufactured, the investment cost would be lower than shown above, but usually one has a fair supply of an old lot on hand when a new lot is started, so the investment cost can be figured to be approximately as indicated. But taken for what it is, it might serve as a general guide for a production man. It can also be seen that the curve representing $y_1 + y_2$ is almost horizontal for a distance on both sides of the minimum, indicating a certain amount of leeway in the amount that can be produced without increasing the cost perceptibly.

SPECIFIC EXAMPLES

To illustrate how this formula works, a number of specific examples are listed below:

Example 1—Sales per month $a = 1{,}000$ lb.; job change cost $b = \$16$; and unit product cost $c = \$1$. Then:

$$x = 10\sqrt{\frac{3 \times 16 \times 1{,}000}{1}} = \text{about } 2{,}200 \text{ lb.}$$

It is evident that it would pay to manufacture about a two-months supply.

Example 2—If the unit cost **c** is \$0.30 and **a** and **b** are the same as above, we would have the following result:

$$x = 10\sqrt{\frac{3 \times 16 \times 1{,}000}{0.30}} = 4{,}000 \text{ lb.}$$

or a four-month supply.

Example 3—Sales per month $a = 30{,}000$ units (which might represent jars of cold cream, tubes of toothpaste, etc.); job change cost $b = \$16$; and unit product cost $c = \$0.10$. Then:

$$x = 10\sqrt{\frac{3 \times 30{,}000 \times 16}{0.10}} = \text{about } 38{,}000 \text{ units}$$

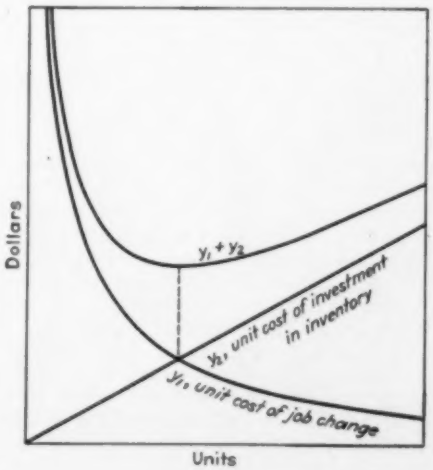
or a five-six weeks supply.

Example 4—If the number of units sold per month **a** were only 3,000 and the other factors the same, we would have:

$$x = 10\sqrt{\frac{3 \times 3{,}000 \times 16}{0.10}} = 12{,}000 \text{ units}$$

or a four-month supply.

Fig. 1 shows that a minimum point is found where unit cost of job change equals unit cost of investment in inventory



CHEM. & MET. PLANT NOTEBOOK

THEODORE R. OLIVE, Associate Editor

$50 CASH PRIZE FOR A GOOD IDEA!

Until further notice the editors of *Chem. & Met.* will award $50 cash each month to the author of the best short article received that month and accepted for publication in the "*Chem. & Met. Plant Notebook.*" The winner each month will be announced in the issue of the next month: e.g., the July winner will be announced in August, and his article published in September. Judges will be the editors of *Chem. & Met.* Non-winning articles submitted for this contest will be published if acceptable, in that case being paid for at space rates applying to this department. (Right is reserved, however, to make no award in months when no article received is of award status.)

Any reader of *Chem. & Met.*, other than a McGraw-Hill employee, may submit as many entries for this contest as he wishes. Acceptable material must be previously unpublished and should be short, preferably not over 300 words, but illustrated if possible. Neither finished drawings nor polished writing are necessary, since only appropriateness, novelty and usefulness of the ideas presented are criteria of the judging.

Articles may deal with any sort of plant or production "kink" or shortcut that will be of interest to chemical engineers in the process industries. In addition, novel means of presenting useful data, as well as new cost-cutting ideas, are acceptable. Address entries to Plant Notebook Editor, *Chem. & Met.*, 330 West 42nd St., New York 18, N. Y.

JUNE WINNER!

A prize of $50 in cash will be issued to

J. E. CORNISH
Beckers Pty., Limited
Dudley Park, South Australia

For an article dealing with a simple electrical system for the separation of immiscible liquids that has been judged the winner of our June contest.

This article will appear in our August issue. Watch for it!

May Contest Prize Winner

MANIFOLDING SERVICE LINES TO PROCESS VESSELS TO PREVENT MIXING OF WATER AND BRINE

J. J. KRAUKLIS
Chemical Engineer
Chicago, Ill.

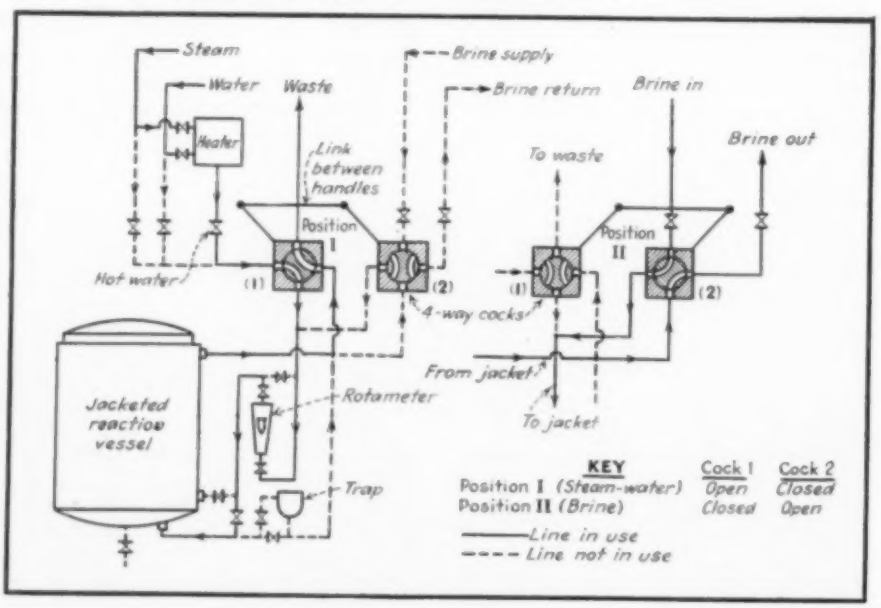
Whenever it is necessary to hook up a jacketed process vessel in such a way that it may be heated with steam or hot water, and then cooled with cold water or brine, a complicated system of service piping and manifolding results and many valves are required. Furthermore, it is easy for the operator to make errors in manipulating the valves in changing from heating to cooling or vice versa, and brine may be lost to the sewer, or water may be forced into the brine line and thence to the brine tank, diluting the brine solution and allowing it to freeze.

The accompanying hookup diagram shows a method of using plug cocks in addition to the usual valves for controlling these services in such a way that cross connection between the heating and cooling medium lines is impossible, while operation is greatly simplified. Two four-way cocks are used, their handles being linked together by a cross-bar so that both cocks are operated simultaneously. Two-way cooks could also be used for this purpose, but a greater number would be necessary and the method of interconnecting them would be needlessly complicated.

As the sketch shows, the cocks are connected in such a way that when one is fully open, the other will be fully closed. For this purpose the total throw of the linked handles must be 45 deg. and a positive method must be used to insure that when one is fully open, the other will be fully closed. Positive stops may easily be developed for this purpose, the exact design depending on the particular design of the cocks used.

In the sketch the services are divided into two groups, with steam-hot water-cold water in one group, and brine supply and return in the other. Either group is available by positioning the plug cocks. For example, position I opens cock (1) and closes cock (2) so that on the supply side the water-steam group of services is connected to the vessel jacket, while on the return side, the vessel jacket is discharged to the sewer. At the same time, both brine supply and

With cocks in the hookup in position I, manipulation of valves permits selection of steam, hot or cold water on the jacket. With cocks in position II, brine is supplied to the jacket and returned to the brine tank



return are blanked off. Alternately, position II opens cock (2) and closes cock (1) so that the brine supply and return lines are connected to the jacket, while the water-steam lines are blanked off.

The other valves shown must of course be correctly operated, although improper operation cannot cross-connect the brine and water systems. The valves provided in the sketch make it possible to supply steam, hot or cold water to the jacket, to insert a trap on the return if steam is being used, or a rotameter on the supply side for controlling water flow rate.

BATCH UNIT SIMULATES C. C. D. PROCESS

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CHEMICAL ENGINEERS and chemists are frequently required to investigate problems involving leaching, i.e., the separation of soluble from insoluble constituents in a mixture, with the aim of designing suitable plant for full-scale manufacturing operations. Among other factors which must be determined are: settlement rates, optimum conditions of acidity, temperature, and so on.

Methods have been developed for translating laboratory data into plant-scale design data, but there will always be an element of uncertainty unless a pilot plant on a moderate scale is interposed between the laboratory and the full-scale plant, and operated for a reasonable period.

An experimental plant for continuous countercurrent decantation is a fairly expensive piece of equipment, both to build and to operate and, furthermore, the operation of such small-scale plant presents difficulties. The apparatus described here was devised as a compromise to overcome these difficulties and proved quite satisfactory in its final results. It approximates countercurrent operation with batch vessels by having the vessels movable, on casters, so that their sequence can be changed.

The setup described was used for experimental work on the production of phosphoric acid from Pacific rock. It gave reliable data in addition to producing a useful tonnage of the product. The same plant could be applied equally well to a wide variety of other leaching and washing operations.

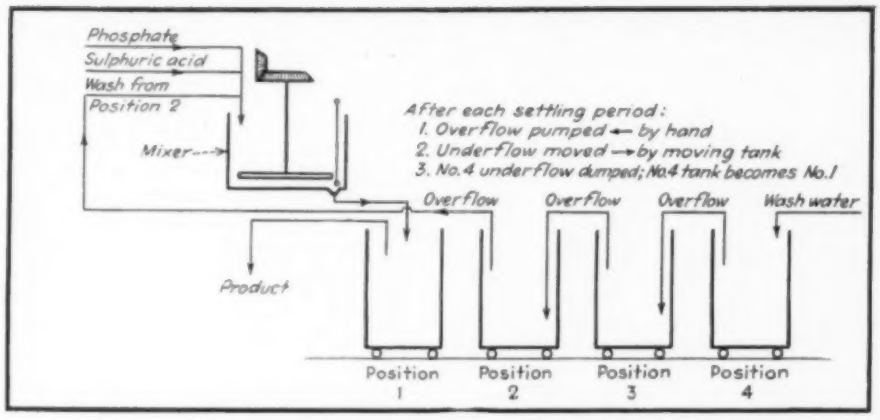
The vessels used, diagrammed in the accompanying sketch, had the following approximate dimensions. The mixer was 3 ft. in diameter and 2 ft. deep. The settling tanks were 2 ft. in diameter and 3 ft. deep. Pumping was done with a 1-in. hand-operated, semi-rotary pump clamped to the lip of each settling vessel in turn, with delivery through a rubber hose.

Agitation was effected by a portable ¼-hp. propeller type stirrer. The vessels were moved by means of the rollers, as shown.

The process was operated in stages. Each stage involves the following steps: First the charge is mixed and run into the vessel at Position 1. After a lapse of time for settling, the supernatant liquor is pumped from Position 1 to the product tank; from Position 2 to the mixer; from Position 3 to 2, 4 to 3, and so on. New wash water is used in the last of the series of vessels. The pulp, plus wash solution in each vessel, is thoroughly stirred at each stage.

The washed underflow from the last vessel is dumped, the empty vessel being transferred to Position 1 to receive the new charge.

Each vessel moves one place to the right at each stage of the operations.



How movable vessels are arranged and used to simulate C.C.D. hookup

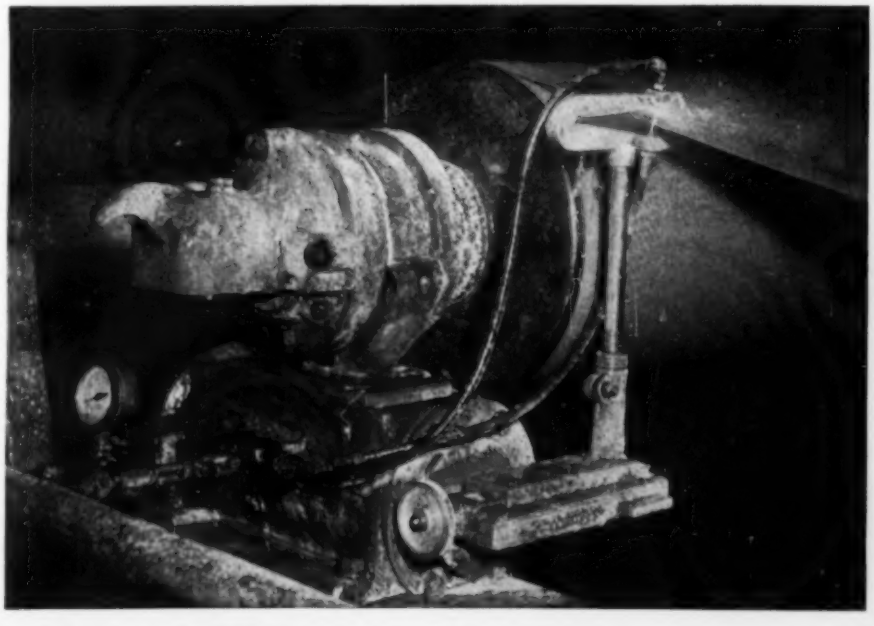
AUTOMATIC WIRE GUIDE FOR PAPER MACHINES

AN INGENIOUS improvement applied to paper machines in the newsprint mills of the Powell River Co., Ltd., at Powell River B. C., is an automatic, hydraulically controlled guide for the fourdrinier wire developed by Ross M. Black, mechanical superintendent. Mr. Black's wire guide, or tracker, for which a patent application has been made, has a number of advantages over the mechanical guides previously used. It minimizes maintenance, acts reliably, has only two adjustments, requires no lubrication and has no pan or palm riding on the edge of the wire. The position of the wire on the fourdrinier may be adjusted by means of a small hand wheel on the hydraulic control unit, while the machine is in operation.

Fig. 1 shows the device installed on the guide roll on the return side of the fourdrinier wire. It consists essentially of a horizontal hydraulic cylinder which serves as a slide base for the guide roll bearing saddle. A projection on the bottom of the saddle extends through the slide, through a slot in the cylinder and into a hole in the piston. The piston is positioned by water admitted to one end or the other of the cylinder under control of a pilot system. The pilot system in turn is controlled by the action of a small water jet located at the edge of the fourdrinier wire. If the wire tends to move sidewise, that is across the machine, either away from or into the guide jet, action of the pilot system moves the cylinder in the proper direction to move the end of the guide roll slightly so as to return the wire to its proper tracking position. This is entirely automatic.

Details of the construction are shown in Fig. 2. The detecting mechanism which

Fig. 1.—Guide roll supported on control cylinder, also showing manual adjustment and control jet



senses the location of the wire is a small yoke carrying at its outer ends a water jet and a pressure-receiving opening opposite the jet. If the edge of the wire moves into the yoke, the jet is cut off and the pressure falls in the control pressure line. If it moves out of the yoke, the control pressure line receives the full impact of the jet. At an intermediate point where the wire edge partially blankets the jet, the control pressure will be at an intermediate value that will maintain the pilot valve system in a neutral position. At other pressures than the one holding a neutral position, the pilot valve will admit water to the cylinder in such a way as to move the wire until the neutral pressure is restored. To prevent "hunting" with minor pressure fluctuations (since the edge of the fourdrinier wire is never straight), a small amount of back lash or free movement is allowed between the piston and the projection on the guide roll bearing saddle. With any change in pressure, this permits one full circuit of the fourdrinier wire before the guide roll actually moves.

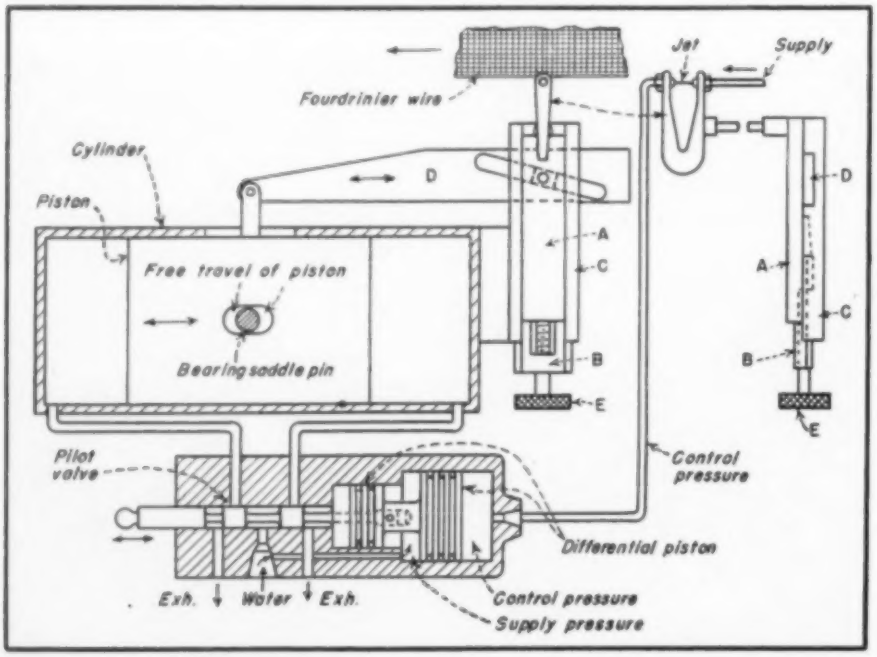
HOW CONTROL WORKS

The controller proper consists of a differential piston moving a piston valve, which in turn controls admission of pressure to the two ends of the cylinder. In order that there may be correspondence between the location of the jet and the motion of the piston (and hence of the guide roll), a "follow-up" is provided which moves the jet as the piston moves, so as to follow the wire if it moves away from the jet, or pull the jet away from the wire if it moves toward the jet. In the diagram the jet yoke is carried on a sliding member *A* and *B* supported on a stationary frame *C*. The arm *D* contains a diagonal slot in which a pin attached to *B* slides. Turning hand wheel *E* adjusts the distance between this pin and the nozzle, thus giving a manual adjustment for the control position of the wire edge. Movement of the cylinder, with this arrangement, causes movement of the jet in whichever direction the wire may move.

Design of the pilot system is evident from the sketch. The differential piston, being loaded on one side with the control pressure, and on the other with the supply pressure, moves the piston type pilot valve in whichever direction unbalance may exist. Actually, the neutral position of the pilot valve is never achieved because the edge of the wire is not straight, but pressure reversals are too rapid to take up the back lash between the piston and the roll bearing and move the roll.

This device has been used with great success for about a year on one of the high speed machines at Powell River, with only a little trouble initially owing to improperly filtered water.

Fig. 2—Diagram of automatic wire guide control at Powell River



NOMOGRAPH PREDICTS CRYSTAL SIZES

IRA J. HOOKS and FRANK KERZE JR.
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In the method of predicting screen analyses in crystallization developed by McCabe, the equation used is as follows:

$$W_p = \int_{.}^{W_s} R\, d\, W_s$$

where $R = (1 + \Delta D/D_s)^3$; W_p = cumulative weight of product; W_s = cumulative weight of seed; D_s = size of seed (Tyler standard screen scale); and ΔD = growth increment.

In the above equation any consistent system of W and D values may be used but the nomograph is constructed on a centimeter basis. The correct ΔD corresponding to a desired W_p is found by graphic trial solutions of the above equation. These calculations can be speeded by use of a nomograph.

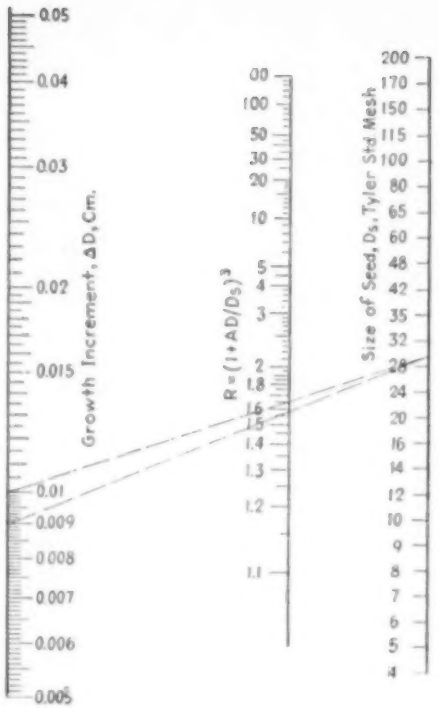

Chart for trial solutions of McCabe screen analysis equation

For illustration we will use McCabe's original problem, assuming the desired $W_p/W_s = 1.57$. The accompanying table provides R values based on $\Delta D = 0.01$ cm. for the first trial. A plot of these R values against W_s results in area $= W_p = 1.65$. Based on total $W_s = 1.0$ the ratio W_p/W_s is identical with W_p.

The above value is too high and to find a better ΔD value connect $\Delta D = 0.01$ through $R = 1.65$ to D_s (now used as a pivot line); connect D_s through $R = 1.57$ to ΔD; read $\Delta D = 0.009$. Continuing the calculation for R values by means of the nomograph using $\Delta D = 0.009$ leads to the desired value of $W_p = 1.57$. It is interesting to note that the line through the desired R and correct ΔD joins the D_s scale near the maximum differential amount and slightly toward the finer screens (between 28 and 32 mesh).

Table of R Values for $\Delta D = 0.01$

	Mesh	D_s, Cm.	W_s	R
on	12	0.1397	0.000	1.23
	14	0.1168	0.001	1.28
	16	0.0991	0.030	1.33
	20	0.0833	0.157	1.41
	24	0.0701	0.287	1.49
	28	0.0589	0.545	1.60
	32	0.0495	0.741	1.74
	35	0.0417	0.874	1.91
	42	0.0351	0.937	2.12
	48	0.0295	0.973	2.40
	60	0.0246	0.983	2.78
	65	0.0208	0.995	3.25
through	65	0.0175	1.000	3.88

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PROCESS EQUIPMENT NEWS

THEODORE R. OLIVE, Associate Editor

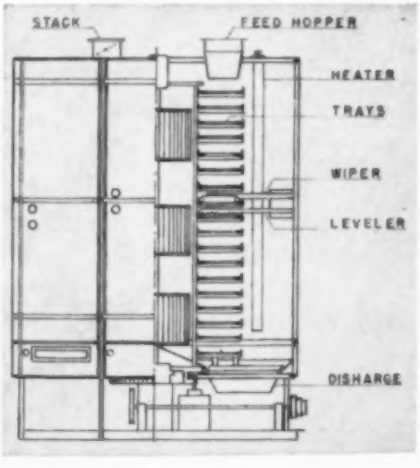
CONTINUOUS PILOT DRYER

CAPACITIES from 2,000 to 10,000 lb. of dried material per day, depending on conditions, for use in small production, pilot-plant and experimental operation, are available in two standard models of the Turbo Dryer offered by Wyssmont Co., 277 Broadway, New York 7, N. Y. A variety of materials ranging from granular to pasty may be handled successfully in producing either dried cake or fine powder. The new machines are 6 ft. in diameter, the 12-shelf being 6 ft. high and the 18-shelf, 8 ft. high. All principal features found in the larger Turbo units are employed. Material travels over a succession of rotating shelves from top to bottom, being repeatedly transferred and spread during the descent, thus exposing new surfaces to the drying current with each transfer. A central fan system provides internal reheating and recirculation for high thermal and high fan power efficiency. Either counter-crossflow or parallel crossflow arrangements may be obtained. Tray systems of steel, Transite, aluminum or stainless steel may be used, with both fin type and smooth surface steam heating elements. Electric heaters may be provided if desired. Units are applicable also for cooling, oxidation and sublimation.

CUSHION IDLER

TO PROTECT conveyor belts against impact at the feed end, Chain Belt Co., Milwaukee, Wis., has introduced the Rex Style 35 Idler, a newly designed troughing type. Each of the three rolls is a rubber cylinder vulcanized directly to the assembly tube. The cylinder has multiple grooves molded into it, primary grooves to provide maximum cushioning alternating with shallow secondary grooves to provide surface softness for protection of the belt against cover laceration. Cushion idlers of this type are used to support the belt directly under the loading point. The manufacturer recommends that three or four units be used, spaced at one-half the normal idler spacing. Each roll is equipped for high pressure lubrication.

Cross section of small-production Turbo Dryer

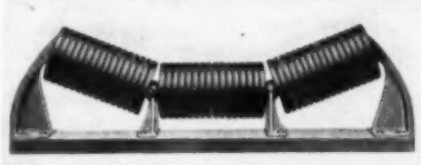


DISK REFINER

DESIGNED for particularly difficult jobs in the pulp and paper industry, a new rotary disk refiner known as Model 36-2 has been introduced by Sprout, Waldron & Co., Muncy, Pa. This single-disk mill is intended for use on kraft, soda and sulphite knotter and fine screen rejects; on hogged bull screen rejects; on knotter and second screen rejects of raw ground-wood; on semi-chemical chips of all kinds; on spent chips from extraction processes; on baggasse, straw and similar grasses; for breaking down lumps in reclaimed waste paper stock; for refining kraft, sulphite and soda fully cooked chemical pulps; and for reduction and refining of rags and other half stocks.

One set of plates is fixed to the mill shell and another to the rotating disk. Stock is introduced in the center between the grinding plates and discharges around the periphery, movement of the stock being effected by the rotating disk which cuts, rubs, rolls and otherwise reduces the stock between the bars of the plates. The plates operate at very close clearances.

Rubber-roll cushioning idler



Vaporsphere for reducing vapor losses

The mill is designed for close adjustment, including an endwise adjustment of the entire rotating unit, plus an adjustment of the peripheral gap, independent of the rotor adjustment, and made by means of a micrometer setting of a ring supported by the mill shell. Power will ordinarily range from 100 hp. for light duty up to the maximum of 400 hp. Capacities vary with the stock and may be from 10 tons to 50 tons air dry rating per day.

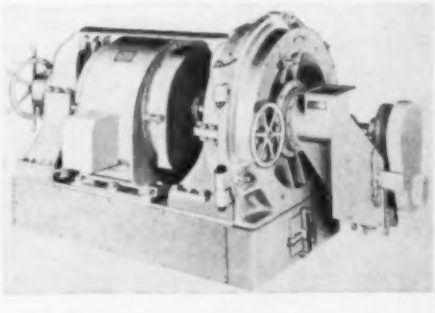
VAPOR EXPANSION TANK

TO REDUCE evaporation losses in the storage of volatile liquids in flat-bottom tanks, Chicago Bridge & Iron Co., 332 South Michigan Blvd., Chicago 4, Ill., has introduced the Vaporsphere, a spherical structure that acts like a gas holder. The first unit has been installed recently at Mobile, Ala. This initial 5,000 cu.ft. tank is a steel sphere which is connected to the vapor spaces of two flat-bottom tanks storing motor gasoline. Within the sphere is a flexible membrane of hemispherical shape connected to the shell at the equator. Vapor is stored beneath the membrane, the space above it being filled with air at all times. When increasing temperature causes expansion in the flat-bottom tanks to which the Vaporsphere is connected, excess vapor flows into the latter. When the temperature decreases, the vapor returns to the tanks. Vaporspheres can also be used to prevent losses from pressure tanks by designing them to operate at the same pressure as the tank and equipping the air space with a pressure regulator.

WELDED HOPPER CAR

A SAVING of 6,540 lb. in weight as compared with the standard steel hopper car has been accomplished in producing an all-welded car that has recently been exhibited in various railroad centers. This car, pioneered by the Railroad Research Bureau of the United States Steel Corp., Pittsburgh, Pa., was built for Carnegie-Illinois Steel Corp., employing U.S.S. Cor-Ten, a corrosion-resistant, high-strength alloy steel. In addition to this smaller weight, permitting that much greater payload, the car presents

Disk refiner for pulp stock



a smoother interior surface which facilitates unloading. It is claimed that the reduction in weight also lessens operating and maintenance costs.

GRINDING CONTROL

CONTROL of the operation of all types of grinding equipment is possible, according to the Gai-Tronics Corp., 1417 K St., N. W., Washington, D. C., with the Gai-Trol, a new all-electronic control device. The equipment consists essentially of a load detector external to the mill and connected directly to the electronic equipment contained in a 66-in. high floor-mounted steel cabinet. A circuit from the electronic equipment in the cabinet supplies a variable-speed, direct-current feeder drive motor. The circuit between the load detector and the feeder is direct and is entirely electronic. Response is said to be instantaneous and direct, the speed of the feed motor being controlled precisely and continuously throughout a stepless range and without lag, intermittent action or hunting. The manufacturers recommend this control particularly for grinding mills in cement plants, powdered coal-fired installations and other types of production where peak grinding efficiency is required at all times.

LOAD HANDLING CART

AMONG new materials handling developments of the Market Forge Co., Everett, Mass., is a newly designed load cart which is particularly useful for handling cement, sand, coal and similar bulk materials, since the height of the cart above the floor makes it convenient to shovel the material in or out. The unit is provided with 16-in. diameter pneumatic rubber tires for easy movement, and has a drop side which may be locked in closed, half opened or fully opened position. The usual troublesome crevice between the drop side and the bottom of the truck has been eliminated by a novel hinge design. Net volume is 22½ cu.ft., and capacity 1,000 lb. In addition to pneumatic tires, semi-steel or cushioned-rubber may be provided. Either one or two drop sides are available.

Another addition to this company's line is a semi-skid and jack arrangement, made entirely of steel without the usual wood deck. The semi-skid is entirely arc welded and designed for use either as a hand or power lift truck. The skid jack is provided with two 8-in. diameter wheels mounted on roller bearings, equipped with a tongue for pulling and a hook arrangement which allows the load to be lifted easily, even when heavily laden.

ATOMIZING NOZZLES

TWO NEW atomizing nozzles have been added to the extensive line of Spraying Systems Co., 4023 West Lake St., Chicago 24, Ill. One is an hydraulic nozzle for atomizing liquids at pressures ranging from 10 to 1,000 lb. Producing a hollow cone spray it is suitable for mounting directly into the wall of processing equipment. The nozzle is made in a variety of materials including brass and stainless steel. It consists of three parts, a body, a cap with a stainless steel orifice insert and a body with a Monel metal strainer or screen. Liquids of the general character of water, oils and solvents may be sprayed. The company has also announced a new pneumatic atomizing nozzle in which the liquid is atomized by means of either air, gas or steam pressure. This nozzle has a removable mounting flange which is part of the nozzle assembly, and a Monel metal strainer in both air and liquid intake chambers. Simple installation, with maximum rigidity, is said to be assured by the design employed.

ROLLER GRAVITY CONVEYOR

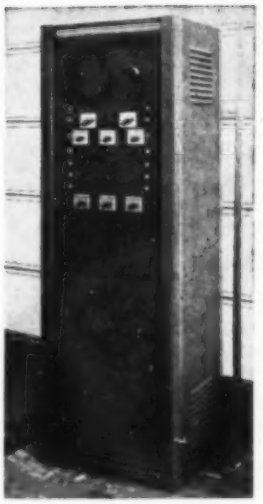
FOR HANDLING materials unsuited to the use of wheel-type gravity conveyors, the Rapids-Standard Co., Grand Rapids, Mich., has introduced a gravity roller conveyor of standardized type suitable for the movement of irregular-surfaced materials, such as cartons, kegs and light drums. Two standard frame lengths of 5 and 10 ft. and two standard widths of 12 and 18 in. are available. Formed of 16-gage steel, the conveyor rollers are 2 in. in diameter and project ⅜ in. above the conveyor frame. The design is such that each roller axle, by its secure attachment to the frame channels, serves as an auxiliary cross brace and gives additional rigidity to the 12-in. conveyor frame which is itself strongly cross braced and arc welded. Rollers are normally spaced at 3 in. intervals, but spacings in any multiple of three can be secured.

CALL-BACK INTERCOM

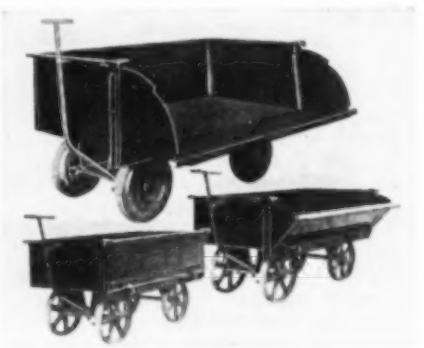
A NEW call-back unit which is said to double the efficiency of intercommunication paging systems by reproducing the paging call clearly and distinctly at as many points as may be desired, and by permitting the person called to reply and converse directly with the executive originating the call, has been introduced in the Model C-18 instrument announced by Executone, Inc., 415 Lexington Ave., New York 17, N. Y. In operation, any person having an intercom master station on his desk can originate a paging call in addition to having regular two-way intercommunication with all other master stations. To page, he depresses the paging button on his master station and calls by name for the person he wishes to locate and speak to. The call is amplified and reproduced by trumpet speakers at various points in the plant. The person paged then goes to a conveniently located call-back reproducer station, depresses a key and automatically is connected directly to the originator of the call. All other amplified reproducers and call-back units are automatically silenced while this two-way conversation is in progress.

POTENTIOMETER PYROMETER

NO CONTINUOUSLY moving or vibrating parts are used in the measuring circuit of the new Pyrotron electronic potentiometer-pyrometer recently developed by Bailey Meter Co., Cleveland 10, Ohio. This instrument records one or two temperatures on a 12-in. uniformly graduated circular chart and indicates on a scale encircling the recording chart. The instrument operates from a thermocouple or other source of potential which is proportional to the temperature, the potential being balanced against a conventional potentiometer circuit. Instead of a galvanometer, however, the Pyro-



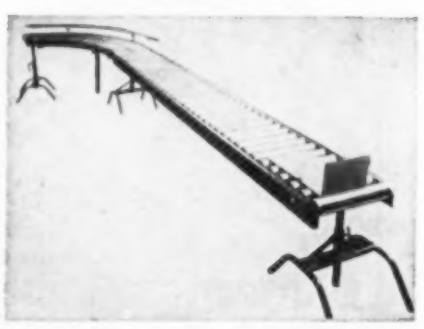
Electronic grinding mill control

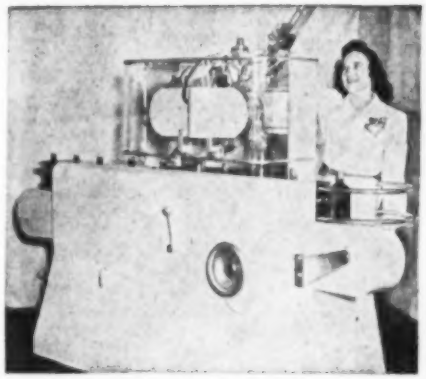


Load cart for bulk materials handling

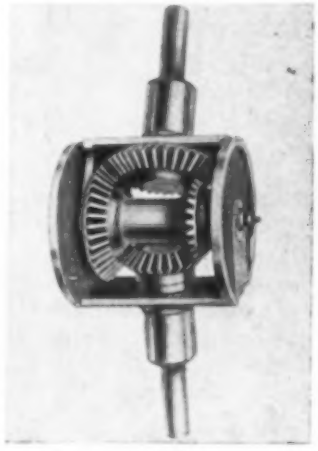
Hydraulic atomizing nozzle

Standardized roller conveyor





Cellulose banding machine



Flexible gear turret

Vapor barrier insulator for piping

30-deg. globe valve

tron uses a d.c.-to-a.c. converter and an electronic detector to measure potentiometer unbalance. The elimination of a galvanometer or similar measuring device is said to minimize maintenance. Only the recording chart moves continuously, the reversible electric motor which drives the indicating, recording and controlling features moving only when the potentiometer network becomes unbalanced due to temperature change. The conversion of direct to alternating potential is accomplished by special saturable core reactors which are similar in construction to transformers and contain no moving or vibrating parts. A single instrument may serve two controllers from two entirely separate measuring circuits, all housed in the same recorder casing. Control may be air operated, on-and-off electric or throttling electronic.

PACKAGING EQUIPMENT

THREE NEW automatic packaging machines were exhibited at the recent Packaging Exposition in Atlantic City by Wright's Automatic Machinery Co., Durham, N. C. Although the machines were developed primarily for use in the beverage and food industries, they are easily adapted to applications in the packaging of drug and cosmetic products. One is an automatic banding machine for applying contractible cellulose bands on liquor bottles. Adjustments are provided so that half-pint, pint, fifth and quart bottles with round necks can now be run on the same machine. The machine comprises a fixed magazine in which the bands are stacked, and a band applying mechanism which receives the band from the magazine, opens it and carries it into position for delivery on the bottle, finally applying it to the bottle as the latter passes through the machine on a continuous conveyor belt. The machine will operate at speeds from 30 to 120 bottles per minute.

Also shown was a new automatic weigher for dispensing small quantities of products such as pills or food products in weights from ¼ to 2 oz. The third device is a cellophane wrapper, developed for packaging 5-cent packs of crackers, but evidently is suitable also for certain small drug and cosmetic packages.

GEAR TURRET

A NEW DEVICE for flexibly connecting power transmitting shafts at any angle between 0 deg. (straight line), and 95 deg. on either side of the zero angle, has been developed in the flexible gear turret offered by Brooks Equipment Corp., 217 Hudson St., Hoboken, N. J. As the accompanying illustration shows, the device uses a unique arrangement of bevel gears attached to shafts which are supported in a hinged housing to permit the shafts to oscillate and rotate simultaneously. Examination of the illustration indicates that the larger pair of gears is meshed and serves to drive the smaller pair through a solid shaft, regardless of the angle of the input and output shafts as they may be swung about the center of the turret housing.

This concern has also introduced other innovations including a line of standardized miter gear boxes for power transmission and agitator driving, equipped with an oil reservoir and self-lubricating Oilite bearings, as well as improved types of steel universal joints.

COLD PIPE INSULATOR

COMBINING insulation and an effective vapor barrier to make a pipe covering has resulted in the development of a new product known as Mystik Self-Stik Dri-Pipe that is produced by Mystik Adhesive Products Division of Chicago Show Printing Co., 2635 North Kildare Ave., Chicago 39, Ill. This material is applied to pipes carrying cold liquids to prevent sweating and dripping. No tools other than a pair of scissors are needed for installation and the material carries its own adhesive along the edges for fastening lengthwise to the pipe. Painting or other covering is not required owing to the use of a moisture-proof, resin-coated cloth backing. The material, which is said to be permanent, is made in one size covering ½-in. and ¾-in. pipe. Larger size pipe, as well as air ducts and tanks, can be covered by splicing to the necessary width, using the material's own adhesive edges.

30-DEG. GLOBE VALVE

IN AN EFFORT to minimize the turbulence and loss of pressure encountered in globe valves, Grove Regulator Co., 65th & Hollis Sts., Oakland, Calif., has developed the Series V and VL valves which employ a 30-deg. valve body that effects a minimum change in direction through the valve. The flow stream is carried through the valve in the direction of closing thus practically eliminating turbulence. Expansion takes place directly into the downstream line after the flow has passed through the valve, almost completely eliminating wire drawing and cutting action, according to the manufacturer. The valve uses a solid one-piece stem and plug, the stem being free to rotate in the hand wheel. It is advanced or retracted by engagement of threads on the latter with similar threads in the valve yoke. This construction is said to avert any possibility of stem distortion. Threaded surfaces and operating parts are protected against dirt and damage by an incasing cap shield. Factory sealed-in lubrication is provided for lifetime service. The new design is available also in a 90-deg. angle pattern and in a variety of valves for quick opening, throttling, shut-off and check services.

LOW-FLOW ROTAMETER

FLOW RATES of liquids as small as 5 ml. per min. and of gases, as small as 20 ml. per min., may be recorded and controlled by means of the new Rota-tronic remote recording rotameter developed by Fischer & Porter Co., County Line Road, Hatboro, Pa. This permits the metering and control of flow rates encountered on laboratory scale operations as well as in small industrial flow applications involving perfumes, vitamin additives, synthetic rubber mercaptan modifiers, and similar uses. The instrument utilizes an impedance bridge for transmitting the flow readings, but unlike larger rotameters of this type, has transmitter coils of extremely small size using very fine wire. The actuating armature attached to the float adds but 250 mg. to the float weight. A similar armature and set of coils is located in the

remote instrument which then employs an electronic power relay to step up the minute power available to the point where it can operate the recording and/or controlling means. This relay controls the energization from an independent power source of a special motor which automatically balances the bridge and indicates the flow rate.

CHEMICAL FEEDER

JUST RELEASED for civilian use, the new Duplex Deluxe Chem-O-Feeder has been announced by Proportioneers, Inc., 29 Codding St., Providence, R. I. This proportioning pump for chemicals is of the diaphragm type and is said to deliver chemical reagents in an almost continuous stream. It is designed for the injection of one or two chemicals at predetermined and adjustable rates, the feeding rate of each chemical being individually adjustable for coarse variations by changing the stroking rate through a two-step cone pulley and belt arrangement. For fine variations, a stroke length adjustment knob is provided to vary the amount of solution fed per stroke.

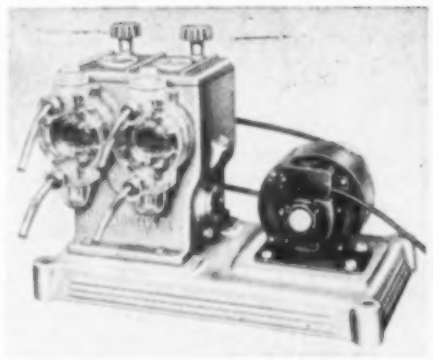
The reagent heads are constructed of transparent plastic material to enable the operator to observe visually the diaphragm and check valve while the equipment is in operation. Since each discharge stroke of the feeder is visible in the sight feeder domes, any feeding irregularity may be detected. The moving parts operate in an oil bath, insuring long wearing life.

TUBE FITTINGS

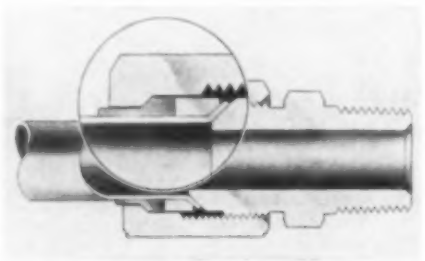
TUBE FITTINGS in sizes from ¼ to 2 in. tube diameter, which may be re-used repeatedly, have been announced in an unusual design by Flodar Corp., 331 Frankfort Ave., Cleveland, Ohio. Known as the Grip Tube type, these fittings consist of three parts, a connector body, a tightening nut and a contractible sleeve which grips the tube. The tube is first flared, then forced against the tapered end of the connector body by means of the tightening nut through the medium of the sleeve. The last is made in one piece and has a solid forward end and a slotted rearward end. The fingers produced by the slots grip the tube securely for absorbing vibration but only after tightening of the nut has forced the solid forward end against the flare of the tube for sealing high fluid pressures. Fittings are said not to twist the tube. They produce a permanent joint, tight against high pressures in excess of the bursting pressure of the tube and they avoid any damage to the flare which might prevent re-use or damage parts of the fitting.

SAFETY EQUIPMENT

SOME 20 new products in the line of safety clothing and equipment have recently been added to those available from American Optical Co., Southbridge, Mass. These include safety goggles, gloves, mittens, a cover-mitt, hand pads, a sleevelet, finger cots, spats and ladder shoes. The new goggles include one for welders, others for protection against flying objects, chemical splashes, dust, and the protection of spectacle lenses. Safety gloves are designed for hot handling, welding and other hazardous jobs. Spats of a number of designs include a type for chemical workers, while the ladder shoes are intended to prevent accidents caused by skidding or creeping ladders.



Duplex chemical feeder



Improved tube fitting

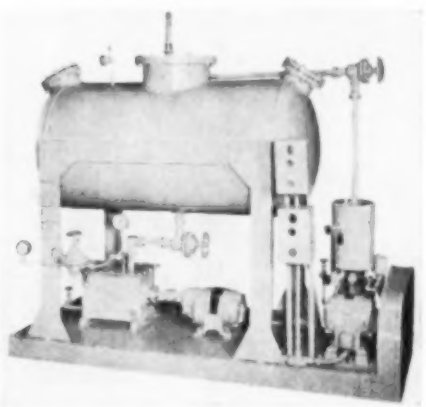
RECORDER-CONTROLLER

FULLY AUTOMATIC recording and controlling of temperature or pressure processes involving a time cycle is the function of the recorder-controller announced by the C. J. Tagliabue Division of Portable Products Corp., 542 Park Ave., Brooklyn 5, N. Y. Only the push of a button is necessary to control processing from start to finish. An adjustable cam starts timing automatically when the temperature reaches the processing point and terminates it at precisely the desired moment. No manual attention is required for the operation of any valves needed in the process. Pilot lights indicate the portion of the cycle being followed, whether heating, cooling, or shutdown.

TANTALUM PILOT PLANT

A WIDE variety of development work in the field of heat transfer, distillation, fractionation, halogenation and absorption of hydrochloric and hydrobromic acids can be carried out in the tantalum pilot plant announced by Fansteel Metallurgical Corp., North Chicago, Ill. The unit consists of a Pyrex tower heated by a tantalum bayonet heater of 0.1 sq.ft. effective area. The tower has a capacity of 100 cu.in. of ¼ in. Berl saddles. A seamless tantalum tube admits solution to the top of the tower, and a second tube, welded to a tantalum base plate, provides for removing effluent. A valve and steam gage are provided in the steam inlet line, and a thermometer well in the condensate line. The condenser, consisting of a tapered tantalum tube in a steel water jacket, has an effective cooling surface of 0.15 sq.ft. and is provided with a tantalum discharge tube. The condenser tube can be arranged either for reflux or condensate discharge requirements. The unit may be cleaned readily without disassembly or sterilized for biochemical work. So far as is known, caustic alkalis, hydrofluoric acid and materials containing more than 10 p.p.m. of fluorides, as well as sulphuric acid, free sulphur trioxide and sulphur monochloride, are the only materials that cannot be handled in this set-up.

New welding gloves and goggles



High vacuum storage tank for dehydrated oil

OIL STORAGE TANK

STORAGE of oils which must be used in the dehydrated condition is the purpose of a new storage tank that has been developed by Buckeye Laboratories Corp., 7016 Euclid Ave., Cleveland 3, Ohio. This equipment is designed for storage of insulating, refrigerating, lubricating, vacuum pump, tung, tall, fish, paint and other oils which must be initially dehydrated, then stored under sufficient vacuum to prevent re-entry of moisture before the oil is used. An extremely low pressure of 5 microns is maintained on the oil after it has previously been dehydrated by means of this company's Buckeye process. This process first atomizes the oil to facilitate separation of water, gases and volatile acids, then subjects the atomized oil to a high vacuum.

FURNACE CLEANER

HARD SLAG and other combustion deposits can be removed, it is claimed, from tubes and other boiler metal surfaces and from furnace refractory walls by chemical means, using the product known as Gamlenite produced by Gamlen Chemical Co., 1369 Spring Garden Ave., Pittsburgh 12, Pa., and

(*Continued on page 162*)

SKYROCKETED *to oblivion*

CASH STANDARD *Streamlined* PRESSURE REDUCING VALVE TYPE 1000

This Valve DID THE TRICK

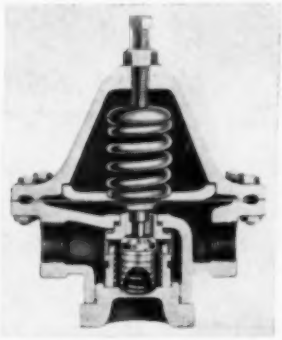
OUT they go on a one way ride that takes these "cost boosters and trouble makers" to a quick ending. There wasn't a chance for them because they were up against *streamline valve* performance. The same thing happens every time in every plant that installs the CASH STANDARD "type 1000" Pressure Reducing Valve.

You can find out the complete details on the "type 1000" by sending for Bulletin 962. See why the straight line flow ends the costs and losses that come with poor valve performance.

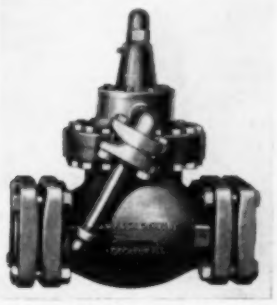
Maximum Capacity When Needed Most • Accurate Pressure Control Under Toughest Working Conditions Trouble-Free Service • Smooth Operation • Tight Closure • Accurate Regulation • Speedier Production Results • Elimination of Failures • Constant Delivery Pressure • Cost Saving Operation • No Spoilage • Practically Zero in Maintenance Costs

BULLETINS AVAILABLE ON OTHER CASH STANDARD VALVES

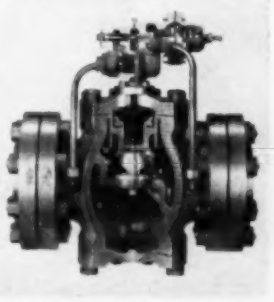
Send for them



Bulletin 950—features the CASH STANDARD Type D Single Seat Pressure Reducing and Regulating Valves for use with most fluids. Shows simple inner working parts that save in maintenance. Diagram explains how valve works. Blueprint shows simplicity of installation.



Bulletin 956—features the CASH STANDARD Type 4030 Back Pressure Valve — designed to automatically maintain a constant pressure in the evaporator corresponding to a constant temperature desired. Shows an Ammonia and Freon Gas Capacity Chart based on ABSOLUTE pressures.



Bulletin 966—features the CASH STANDARD Self-Contained, Pilot Operated Type 10 Pressure Reducing and Regulating Valve for use with water or air; with any gas or oil that is non-corrosive; and with refrigerating fluids such as Ammonia and Freon. Many interesting particulars explained such as: how valve works, tight seating, large capacity, no waste, no water hammer or chatter.

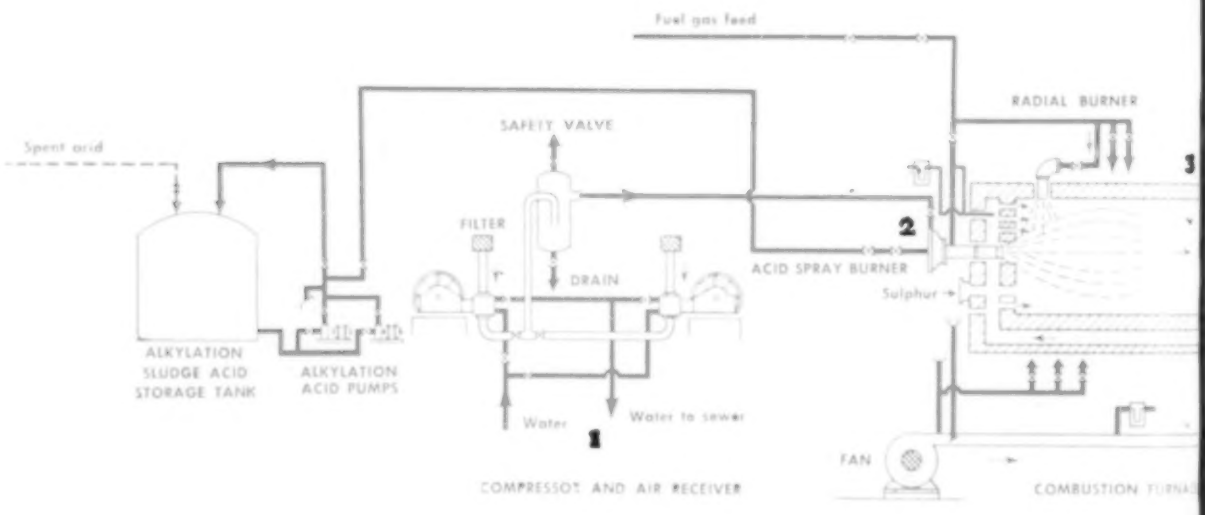
CASH STANDARD CONTROLS.. VALVES

A. W. CASH COMPANY
DECATUR, ILLINOIS

Photographs by Elwood M. Payne

Conversion of spent acid from sulphuric acid alkylation process to strong pure acid is carried out at Houston, Tex., plant of Consolidated Chemical Industries

1 Air compressor in center foreground, air blower for recuperator at left and large blower for sulphur dioxide in contact system in center behind compressor



ALKYLATION ACID REGENERATION PLANT

RECLAIMING of 98 percent sulphuric acid from this alkylation spent acid is being done by three organizations on the Gulf Coast, one of which is the Consolidated Chemical Industries at its Houston plant. The spent acid when decomposed at high temperature breaks down into its components, SO_2, H_2O, and O_2. After proper processing the gases are converted into strong pure acid.

The plant is advantageously located in the neighborhood of several petroleum refineries which used the alkylation process. The spent acid they supply the Consolidated Chemical plant usually contains by weight: acid, 85 to 90 percent; water 2 to 4 percent; and hydrocarbons 6 to 10 percent. It is black and fluid at atmospheric temperatures.

Briefly, the Chemical Construction Corp.'s process in use in this plant consists of spraying the spent acid into a furnace where it is decomposed to form sulphur dioxide at a temperature of approximately 2,200 deg. F. Hydrocarbons in the sludge, with the addition of gaseous fuel (if needed), furnish the heat required in the process. Gases leaving the furnace pass through a recuperator where heat is recovered by preheating the air entering the furnace. The hot gases are then scrubbed with acid and cooled by direct contact with water. Sulphur dioxide in the water leaving the tower is recovered by stripping with air. Sulphuric acid mist is removed in an electric mist precipitator operating at 80,000 volts. Water vapor is removed by scrubbing with sulphuric acid in a drying tower. The circulating acid is cooled in a suitable cooling system. A centrifugal blower is located after the drying tower to propel the gases through the system. The SO_2 gases are then preheated and converted to SO_3 by passing through layers of vanadium catalyst. The hot gases leaving the catalyst layers are used to preheat the incoming SO_2. The SO_3 leaving the converters is absorbed in strong sulphuric acid where it combines with water to form 98 to 99 percent H_2SO_4. The acid is cooled in a suitable cooling system. Acid lost in the alkylation and regeneration cycles can be made up by burning sulphur or hydrogen sulphide in the combustion furnace.

For a detailed article see pp. 102 to 105.

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July 1946

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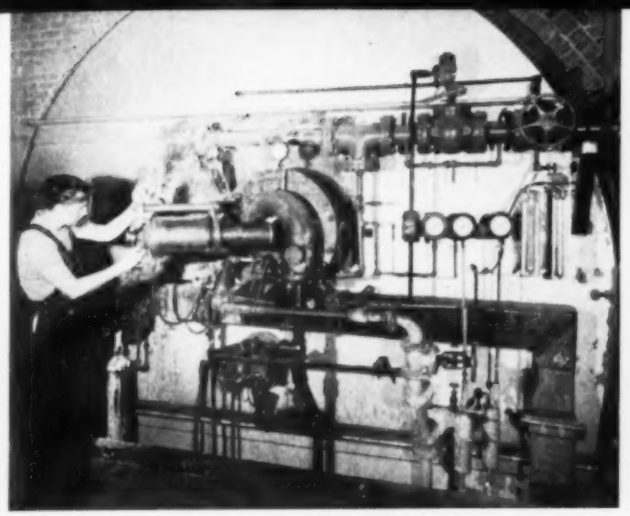
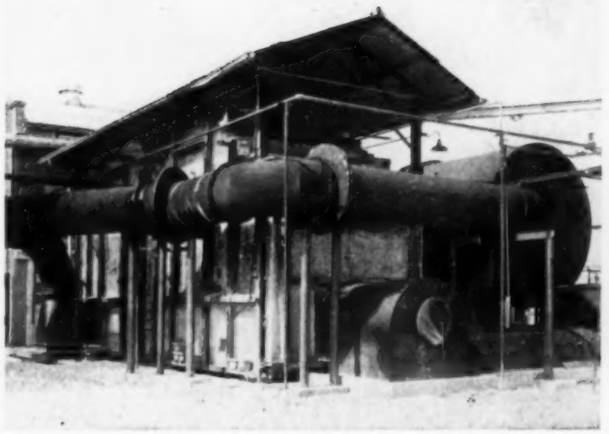
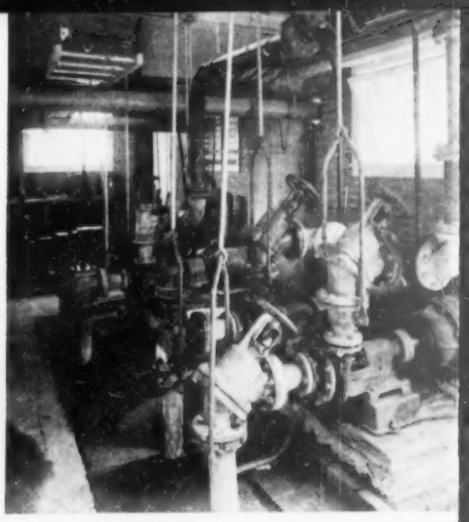


2 Spraying spent acid into furnace where it is decomposed at 2,200 deg. F. Hydrocarbons in sludge, with addition of gaseous fuel (if needed) furnish heat required



4 Gases pass to recuperator, silicon carbide tubular heat exchanger of Fitch type where they are partially cooled to 1,200 deg. F., giving up heat to air which is used in furnace



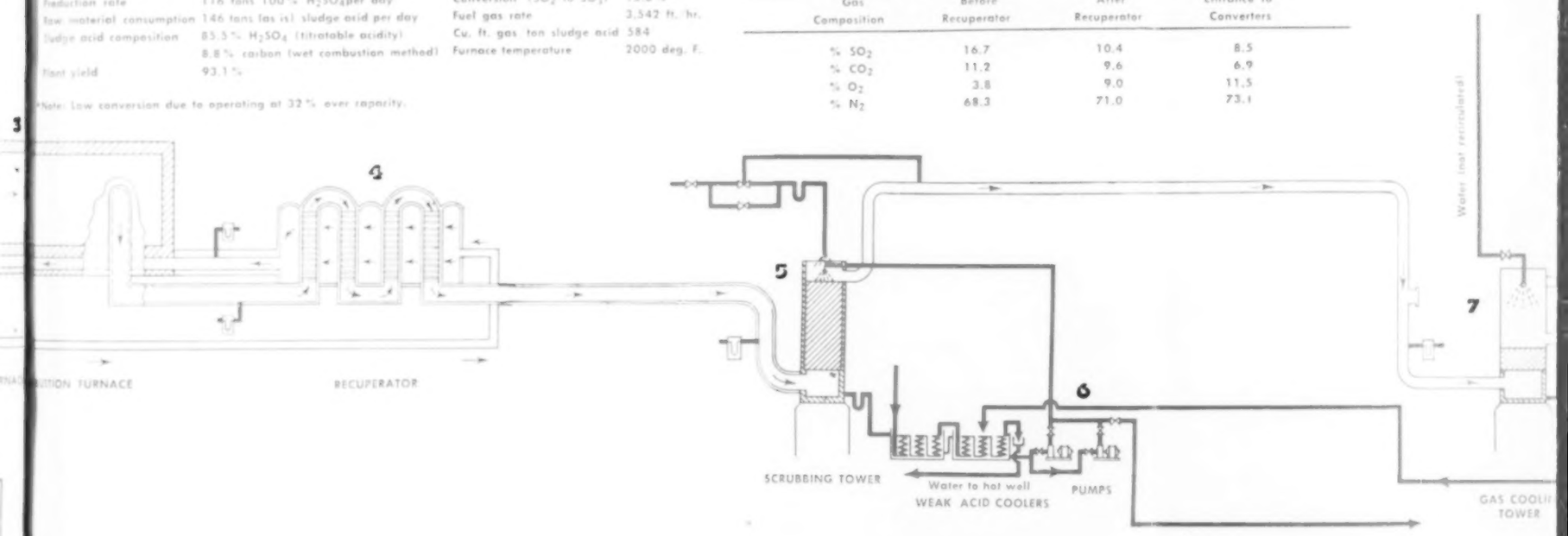
6 Acid of 46-60 deg. Be. is pumped over se and water is circulated over stripping tower sh left in photograph 5.

Plant Operation for a Typical Day

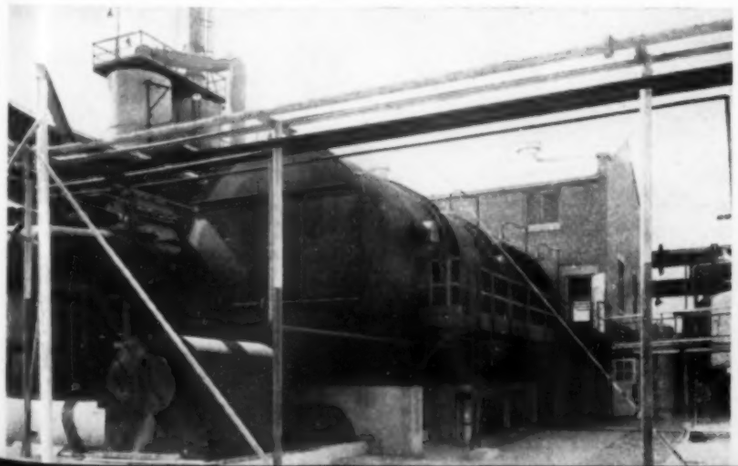
Production rate	116 tons 100% H_2SO_4 per day	Conversion (SO_2 to SO_3)	95.8%*
Raw material consumption	146 tons (as is) sludge acid per day	Fuel gas rate	3,542 ft./hr.
Sludge acid composition	85.3% H_2SO_4 (titratable acidity)	Cu. ft. gas/ton sludge acid	584
	8.8% carbon (wet combustion method)	Furnace temperature	2000 deg. F.
Plant yield	93.1%		

*Note: Low conversion due to operating at 32% over capacity.

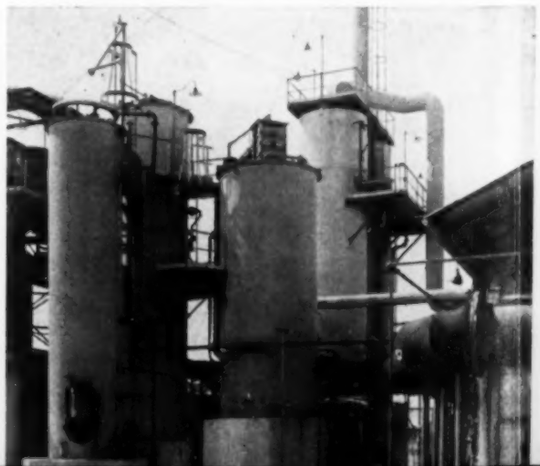
Gas Composition	Before Recuperator	After Recuperator	Entrance to Converters
% SO_2	16.7	10.4	8.5
% CO_2	11.2	9.6	6.9
% O_2	3.8	9.0	11.5
% N_2	68.3	71.0	73.1



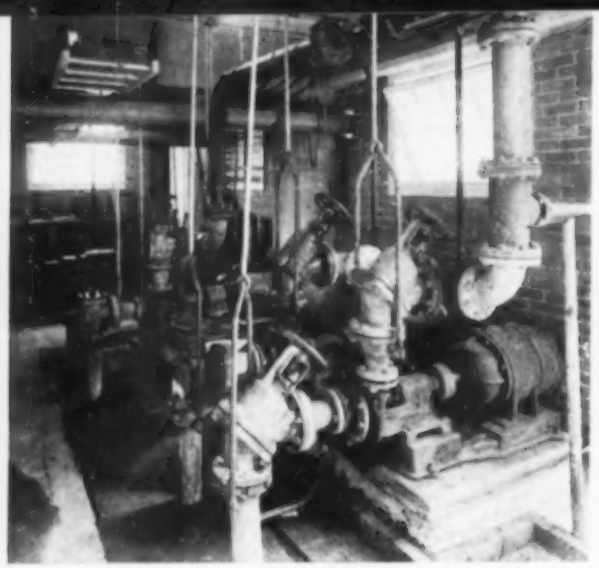
3 In a furnace, consisting of a brick-lined steel shell, spent acid is decomposed completely to SO_2, H_2O and CO_2. Acid lost in regeneration cycle can be made up by burning sulphur or hydrogen sulphide in furnace



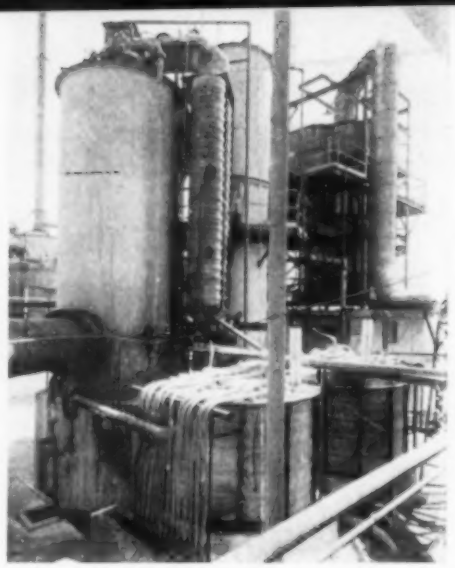
5 From recuperator gases enter scrubber tower (center) and are cooled to 200-250 deg. Acid mist which might be formed is partially removed in tower



A Chem & Met PICTURED FLOWSHEET



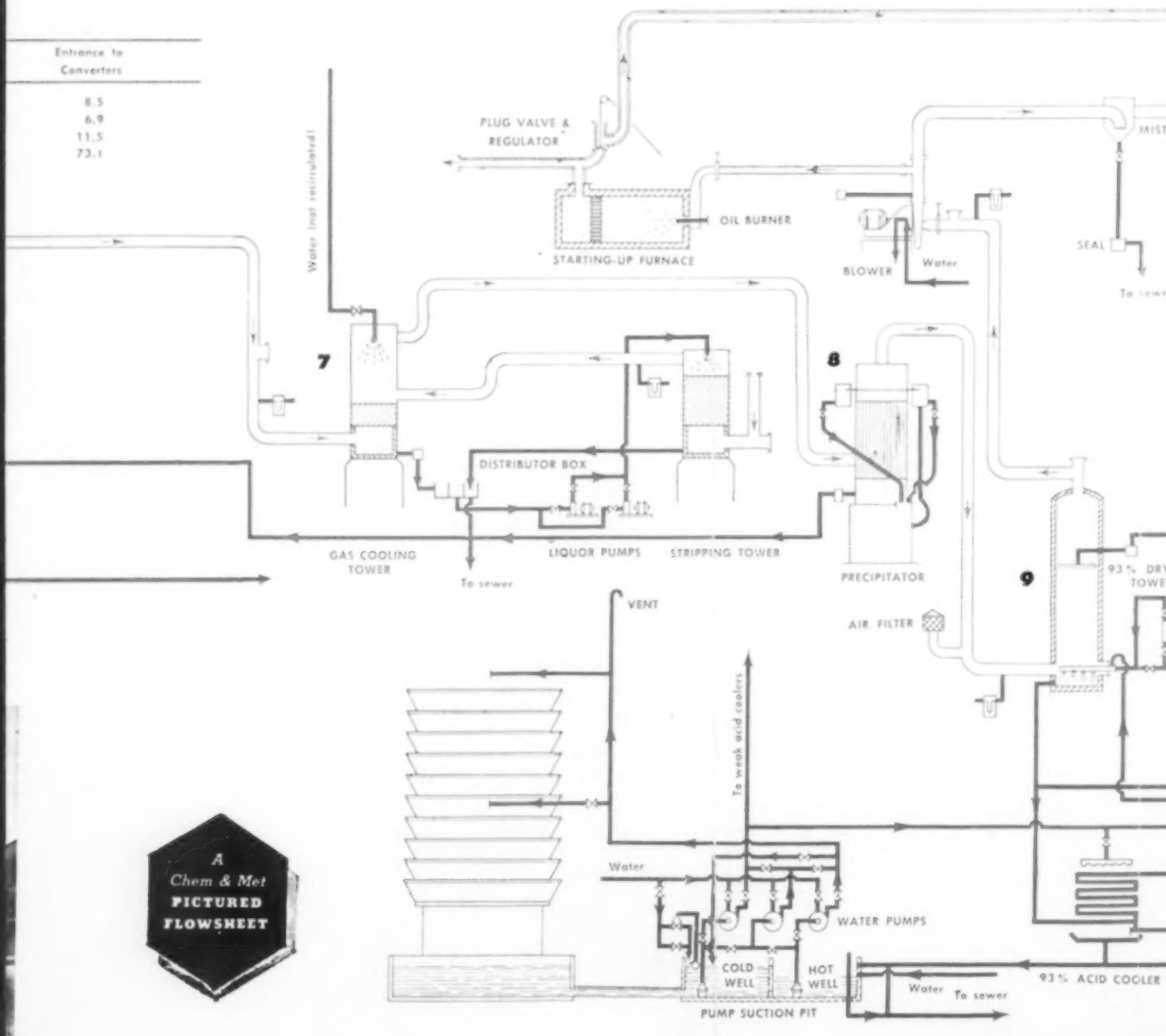
6 Acid of 46-60 deg. Be. is pumped over scrubber and water is circulated over stripping tower shown on left in photograph 5.



7 Recirculating liquor in scrubber is cooled by means of water flowing through lead coils in lead cooling tanks

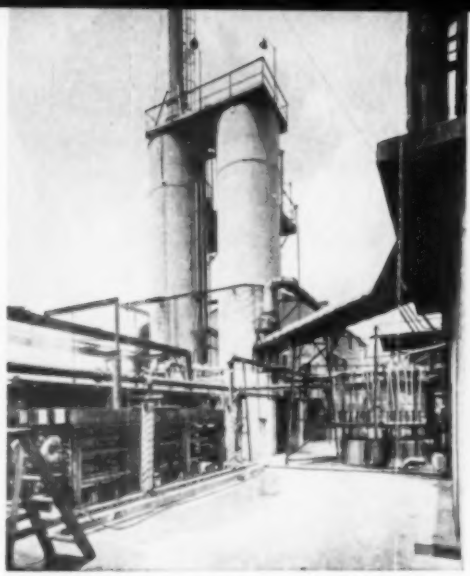
8 Gases from cooling towers co mist which is removed in Cottrell tors. Acid solution goes to cooler

Entrance to Converters
8.5
6.9
11.5
73.1

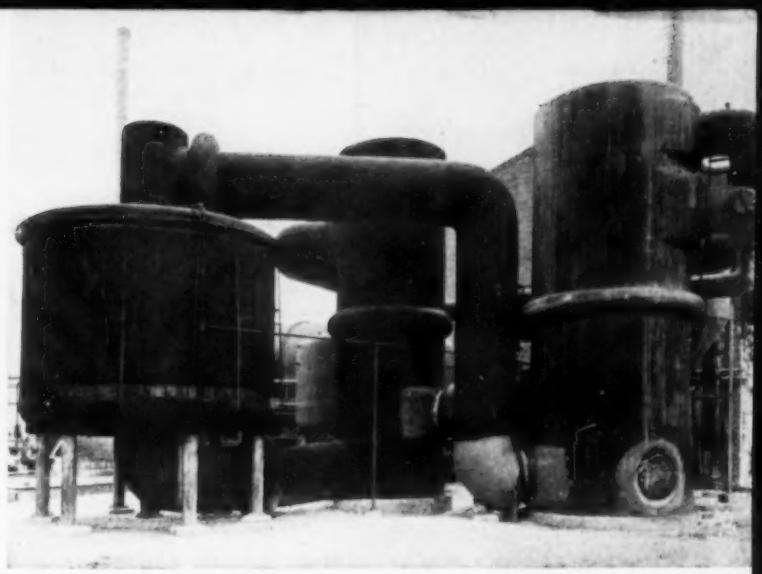


A Chem & Met PICTURED FLOWSHEET

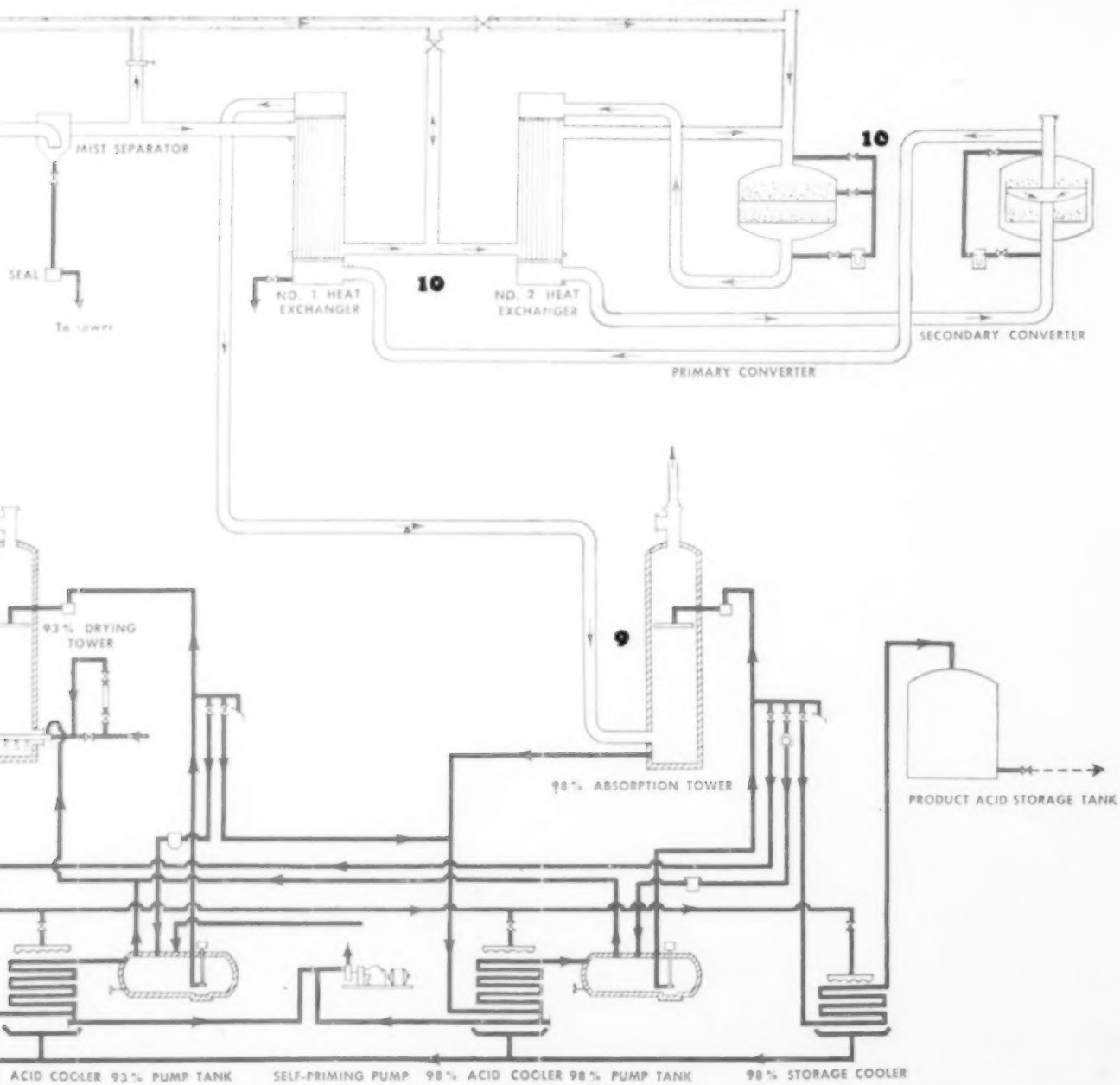
towers contain acid
in Cottrell precipita-
es to cooler tanks



9 Moisture in clean gases is removed by absorption in 93 percent acid which is circulated over drying tower (right)



10 SO_2 gases are preheated and converted to SO_3 by passing through vanadium catalyst. Hot gases leaving converters are used to preheat incoming SO_2 in heat exchangers



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War-time Shortage Produced a BETTER RUBBER for TEXROPE V-BELTS

LACK of natural rubber forced the development of synthetic rubbers. And out of this intensive war-time research came a rubber compound that has made today's TEXROPE "Super-7" V-Belts the BEST in 20 years of V-Belt experience!

This war-proved Buna-S develops 75% less internal heat. It's tough, durable, resilient. It cushions, insulates and protects the load-carrying cord structure — adds to the service life of the belt.

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TEXROPE V-BELT DRIVES

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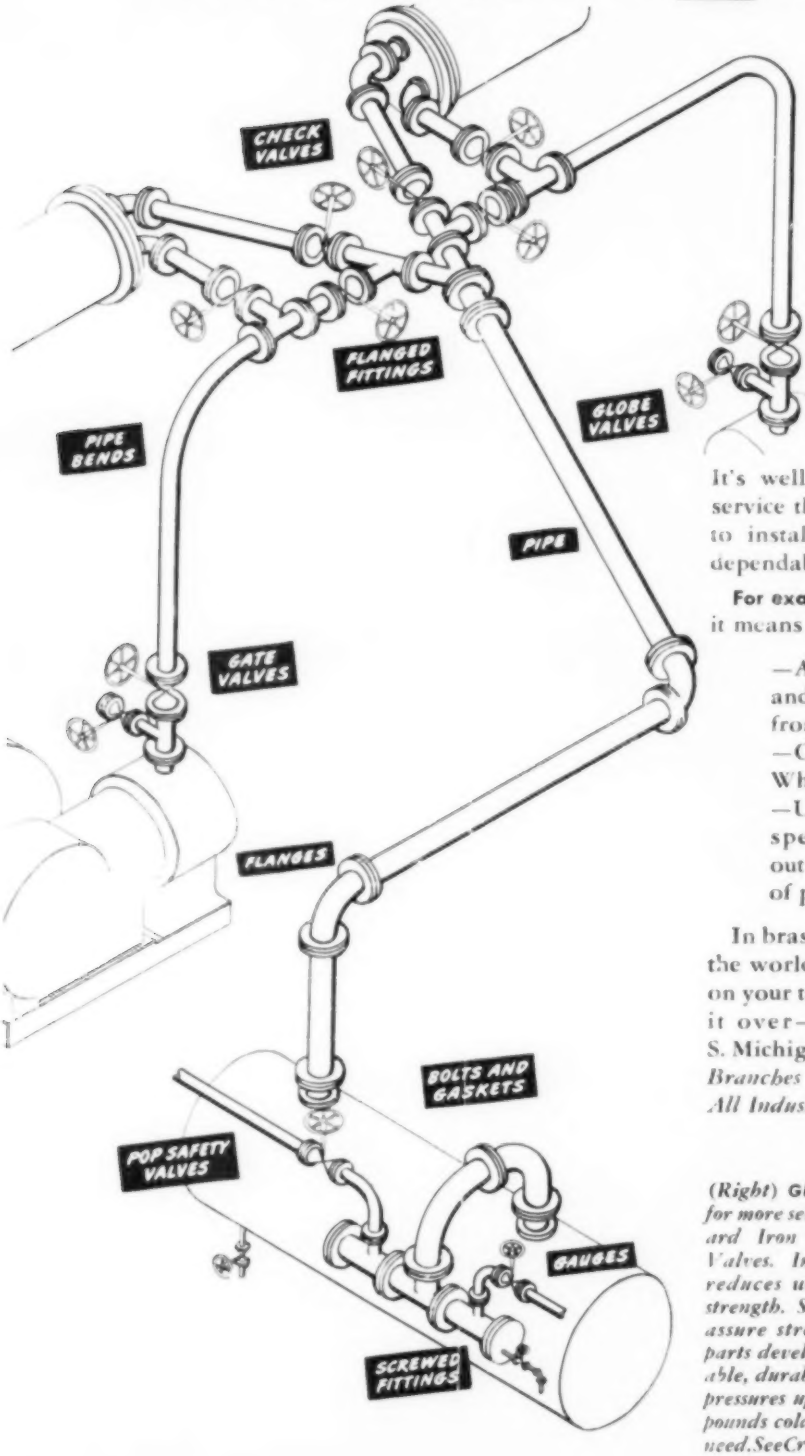

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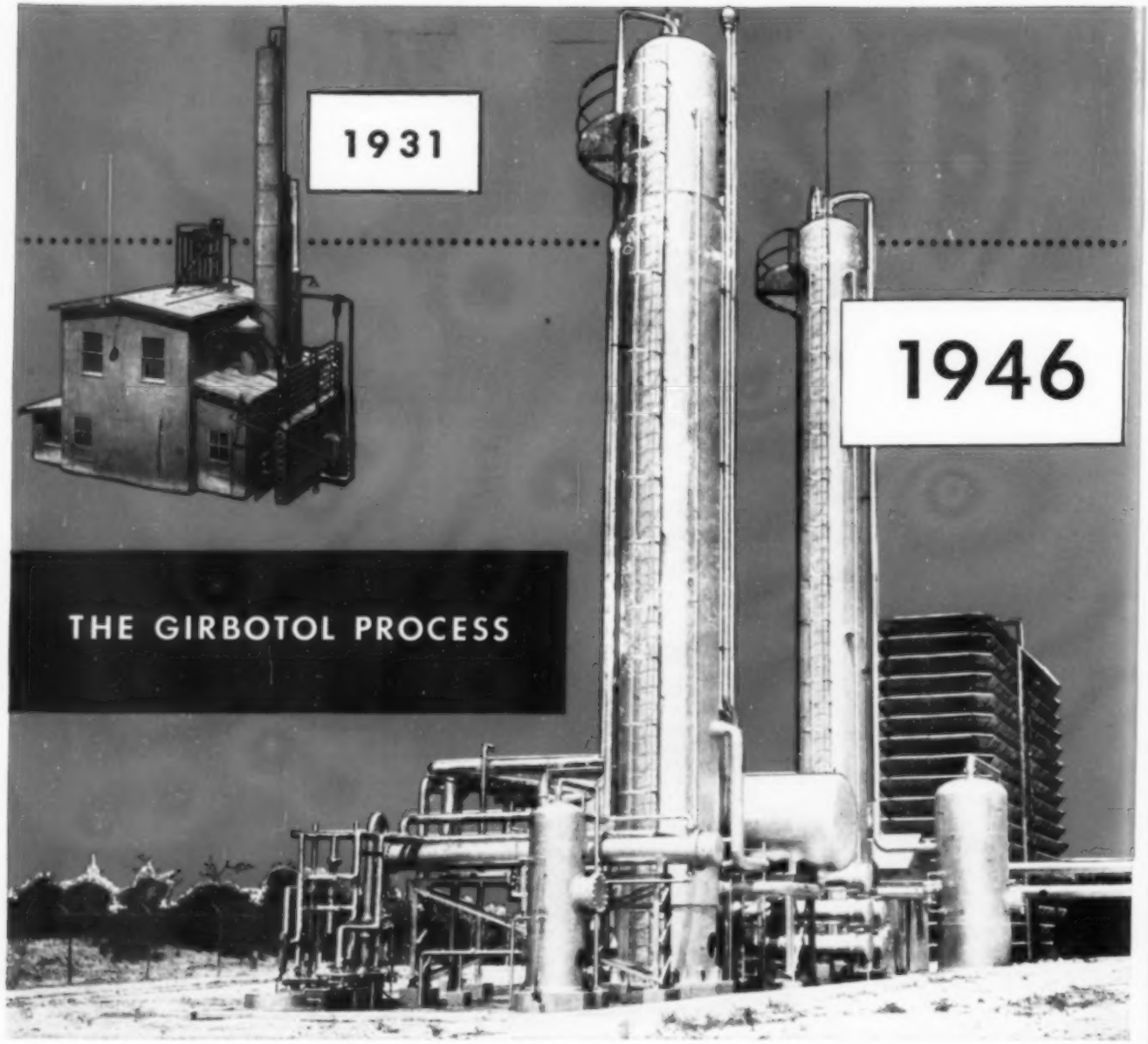
FOR EVERY PIPING SYSTEM



a **continuing development** *by Girdler*

GIRDLER'S development work on the GIRBOTOL PROCESS was not finished with completion of the first GIRBOTOL plant for the removal of hydrogen sulphide from natural gas. It was only the beginning.

Girdler specialists in gas processes have designed hundreds of these plants for the effective, economical removal and recovery of hydrogen sulphide and carbon dioxide from gases and liquid hydrocarbons. All plants are different. Each is especially designed to incorporate the latest findings of Girdler's intensive laboratory research and wide practical experience. Each is especially designed to fit individual requirements and local conditions.

No two gas processing situations are exactly alike, and the Girdler development work which is a part of every GIRBOTOL plant can come only from Girdler. When you need a GIRBOTOL Plant, don't accept a "substitute." Be sure of the specialized engineering which will fit your particular requirements. Put Girdler on the job.

• • •

Girdler offers processes for *gas manufacture, purification, separation, and dehydration.* Consult Girdler about your problems concerning *hydrogen sulphide, carbon monoxide, carbon dioxide, inert and controlled atmospheres, natural gas, refinery gases, liquid hydrocarbons, hydrogen, nitrogen.*

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NEW PRODUCTS AND MATERIALS

R. W. PORTER, Assistant Editor

PURE FLUORINE GAS

ONE of the most active chemical elements, fluorine, has recently been placed on the market in limited commercial quantities by the Pennsylvania Salt Mfg. Co., Widener Bldg., Philadelphia, Pa. Manufactured by electrochemical methods (for complete details turn to pp. 106-8) this hitherto unobtainable chemical is available in steel cylinders containing ½ lb. fluorine compressed to 400 lb. per sq.in. Its initial cost is $20 per lb.

Fluorine is a nearly colorless gas about 30 percent heavier than air. Physically, it resembles the fixed atmospheric gases, oxygen and nitrogen. The gas can be condensed below the critical temperature of —129 deg. C. to a liquid. Liquid fluorine boils at 187 deg. C. under 1 atm. pressure. Having a strong chlorine-like odor similar to that of ozone, it is highly irritating. Hazards of exposure are claimed to be about the same as for chlorine.

Reacting strongly with silicon containing compounds, it can support continued combustion of glass and asbestos. Fluorine reacts vigorously with most metals at elevated temperatures. It readily displaces chlorine and other halogens from solid metal halides such as salt, and reacts immediately with water to form hydrogen fluoride, oxygen, and some oxygen fluoride. Replacement of hydrogen in hydrocarbons by fluorine results in compounds more stable than the original.

Availability of fluorine may be expected to intensify research in the field of fluorine compounds. Many new products, still in the development stage, show considerable promise. One of these is an organic fluoride liquid (a highly fluorinated hydrocarbon) non-flammable and non-toxic, with a high enough boiling point and specific gravity that it can replace mercury in the present mercury vapor boiler. Another is a gas, sulphur hexafluoride, already developed but requiring elemental fluorine to manufacture, said to be a more nearly perfect insulator than is presently available for high voltages used in X-ray and nuclear physics work. Other possible new products which may be derived from fluorine include a new stable lubricant, insecticides, anesthetics, solvents, fireproofing materials, etc.

Fluorine can be handled at atmospheric or moderately elevated temperatures in several metals with little or no corrosion. These include iron, nickel, copper, magnesium, nickel and Monel. In valves and other equipment where abrasion might occur it is desirable to use Monel or nickel.

Fluorine combines with hydrogen in water to support combustion

SLIME CONTROL AGENT

EFFECTIVE control of slime, particularly in pulp and paper mills, can be obtained by using the new fungicide now manufactured commercially by the Mallinckrodt Chemical Works, 2nd and Mallinckrodt Sts., St. Louis, Mo. This new product, under the brand name of Pyridose, is actually pyridylmercuric acetate which is claimed to have outstanding fungicidal and bactericidal properties of mercurials plus good water solubility. In addition, the compounds formed from Pyridose with the ions common in water are more soluble than the corresponding salts of other organic mercurials. It is claimed that tests have been made to determine the minimum concentrations of Pyridose required to prevent the growth of several common slime forming organisms. Pyridose in the concentration of 0.0001 percent is said to inhibit the growth of *Aerobacter aerogenes*, 0.000051 percent inhibits the growth of *Bacillus mycoides*, and 0.005 percent inhibits the growth of *Aspergillus niger*. It reacts with chloride present in water to form pyridyl-mercuric chloride.

Slime is composed chiefly of microorganisms, fungi and bacteria together with partially decomposed pulp and causes unsightly blotches on finished paper. It also shortens the life of paper machine felts. While treatment of mill water with chlorine and ammonia helps to control slime, it is often insufficient, especially in the summer months. For most conditions, a 1 oz. dose of Pyridose is sufficient to treat 10 to 15 tons of pulp (dry basis) but greater concentrations may be necessary to handle severe or unusual conditions. It is usually most satisfactory to add this material to the beaters where it is rapidly mixed with the pulp. It is claimed that Pyridose will remove slime from the most infected systems without necessity of costly shutdowns. However, the slime should not be removed too quickly since large portions may break away and circulate in the system. Pyridose is supplied in bulk and in convenient 1 oz. paper packets, 200 to a case. These packets may be thrown unopened into the beater. These convenient packets eliminate the necessity for weighing out small portions of the chemical from bulk containers thereby preventing spillage and loss in handling. It is also supplied in 25 lb. fiber drums.

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HIGH DENSITY ALLOYS

PRODUCED by powder metallurgy, a series of high density alloys has recently been announced by the Callite Tungsten Corp., Union City, N. J. Having the brand name of Dense Alloy 112, they are available in three general types. Type P is composed largely of tungsten, copper, nickel and small percentages of other ingredients. Type E consists largely of tungsten, cobalt and silver. Type Y is composed mainly of tungsten, cobalt and nickel. They are available in round, square and special shapes and can be brazed or soldered by standard commercial methods. They are claimed to have ready machinability, and are said to be especially adaptable as balancing weights where space is a prime factor. The high density of these alloys is shown by comparing with lead. Lead has a density of 0.41 lb. per cu.in. while Dense Alloy 112 weighs 0.62 lb. per cu.in. They have tensile strengths ranging from 60,000 to 80,000 psi.

Another family of alloys developed by this company is Type SM silver-molybdenum alloy which is a high conductivity facing material suitable for electrical applications re-

quiring high current where pitting, sticking or welding of contact occurs. It is used in switchgear designed to handle heavy currents. It is available in three grades, namely: SM-1, SM-2, and SM-3, which vary in hardness and conductivity.

TRANSPARENT WATERPROOFING

USED on a limited scale for a number of years, a transparent waterproofing compound under the brand name of Hydrozo is now commercially available from the National Hydrozo Co., 5234 St. Clair Ave., Cleveland 3, Ohio. This material is a colorless liquid made by reducing a synthetic mineral gum with a volatile thinner to form a light amber liquid which resembles paint oil in consistency. When properly applied, it is claimed to permanently waterproof concrete, brick, stone, tile, stucco and wood. It is unaffected by strong acids. Hydrozo is claimed to penetrate deep into pores and shrinkage cracks, forming a nonoxidizing water repellant seal that is quite durable. It prevents efflorescence and forms a good surface for finished paint coats. In application, the entire surface being treated should be completely saturated with two coats applied not less than 24 hours apart. A third coat may be necessary on interior walls for extreme cases of pressure seepage. Each gallon covers from 100 to 200 sq.ft. or more of surface with two coats, depending more or less on the porousness of the material being treated. Although it is a colorless liquid, it can be mixed with color if this is desirable. Hydrozo is packed in 1 gal. containers, 4 to a case, also in 5 gal. cans and in 30 and 55 gal. drums.

ALKALINE DETERGENT

NOW COMMERCIALLY available for shipment, a special paper mill felt washing detergent under the brand name of Nu-Nap is manufactured by the Cowles Detergent Co., Paper Chemical Div., 7016 Euclid Ave., Cleveland 3, Ohio. Nu-Nap is a white, uniform, free flowing alkaline detergent containing 100 percent active ingredients. A completely anhydrous product, it is equally effective in either hard or soft water and is claimed to wash clean, rinse freely and leave the felt soft and absorbent. It is available in two grades, one for use on the paper machine and another grade for use either on the machine or in a felt washer. It is used in concentrations of 3 to 8 lb. per 50 gal. of water for various types of use. It is available in 400 lb. open head drums.

DRILLING COMPOUND

DEVELOPED by Johan Bjorksten, Industrial Research Chemist, 185 No. Wabash Ave., Chicago 1, Ill., a new drilling fluid, known as Drillyfe, is being produced in commercial quantities for use in all types of metal drilling work. This soluble type drilling compound is now being commercially manufactured by the Bee Chemical Co., 63 E. Lake St., Chicago 1, Ill. It is claimed to have several advantages over other types of drilling compounds. Drillyfe is non-foaming, is mildly germicidal, contains no irritating ingredients, and is a mild corrosion preventive. Drillyfe is primarily intended for use with ferrous metals. It shows good performance with stainless steel and other ferrous alloys. It does not stain aluminum although it may discolor copper-containing metals and, therefore, is not recommended for copper or brass. It is usually mixed with water in the ratio of 1 part Drillyfe to 10 to 20 parts of water although special jobs may require different mixtures. A stable emulsion is obtained even with waters having hardness as high as 500 ppm. This emulsion withstands the action of centrifugal pumps and sudden changes in the direction of flow. Its use is claimed to result in cooler operation which permits closer tolerances in the work and less distortion of the product.

ALKANE SULPHONIC ACIDS

RECENTLY announced by the Standard Oil Co. (Indiana), Chemical Products Department, 910 So. Michigan Ave., Chicago 80, Ill., alkane sulphonic acids are now available in small quantities for research and evaluation work. Methane sulphonic acid, ethane sulphonic acid, and mixed alkane sulphonic acids are strong, stable, non-oxidizing acids which resist the action of chlorine and bromine, the hydrolyzing action of water and alkalis, and do not react with aromatic and paraffin hydrocarbons. They do react with common metals, oxides and hydroxides forming water soluble salts. These acids catalyze polymerization, condensation, alkylation and other reactions. The corresponding acid chlorides are reactive and lead to various derivatives. Metal salts have novel and interesting properties in electrochemical processes such as electroplating and refining.

Alkane sulphonic acids are thermally stable at moderate temperatures but decompose at temperatures above 150 deg. C. They are corrosive to most common metals, however, stainless steels are relatively resistant. Rubber is attacked at temperatures in the vicinity of 100 deg. C. and higher. Methane, ethane, and mixed alkane sulphonic acids are available in ½ and 1 lb. containers. It is claimed that metal plating can be speeded up considerably by using these new sulphonic acids which are said to give not only faster plating but brighter finishes as well. They can be used over a wide range of operating conditions. Some of their properties are listed in the accompanying table.

Properties of Alkane Sulphonic Acids

	Methane Sulphonic Acid	Ethane Sulphonic Acid	Mixed Alkane Sulphonic Acids
Formula	CH_3SO_3H	$C_2H_5SO_3H$	RSO_3H
Molecular wt.	96	110	110–120
Sp. gr. (25/4 deg. C.)	1.48	1.35	1.25-1.35
B.p., deg. C. (1.8 mm.)	127	129	
Color	pale yellow	yellow	amber
Odor	mild	mild	sour
Purity, percent	95+	95+	95+ Methane, ethane and propane sulphonic acids

QUICK DRYING LACQUER

MANUFACTURED by Maas & Waldstein Co., 438 Riverside Ave., Newark 4, N. J., a new high gloss protective and decorative coating for polystyrene plastics is now commercially available. Stylac clear lacquer No. 79 is a water white, air drying material for use on polystyrene products. It has good adhesion and humidity resistance and dries out to a tough, high gloss finish with no tendency to cause crazing. Stylac may be applied by spray, dip or brush and can be used with concentrated colors to produce transparent effects. It dries in 5 to 10 min. and is hard in 1 hr. It can be used as a clear top coat over silver nitrate coatings.

Another new coating available from this company produces a lustrous hammered effect in a single spray coat application. This product, known as Motletone, is available as an air dry or baked finish and may be used on metal equipment of various kinds. It may also be used on molded plastic products and on wood when this type of finish is desired. It is claimed to have the ability to hide weld dimples, scratches and other small defects and is recommended where low cost finishing is required.

DEGREASING AGENT

DEVELOPED during the war as a cleaning and protective agent, an emulsifying degreaser under the brand name of G-Bex-D is now commercially available from the Gaybex Corp., Nutley 10, N. J. This material is a neutral emulsifying solvent having a minimum flash point of 165 deg. F. It is non-irritating to the skin and is considered non-corrosive to most common metals. It will not affect paint or lacquer and may be used for light or heavy duty degreasing by spray, brush or soak application followed by a water rinse. It leaves a slight protective film even after it has been water rinsed and will thereby protect the work from finger prints. It is available in 5 to 54 gal. drums.

RESIN PLASTICIZER

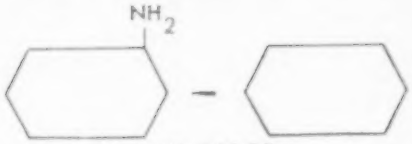
ANOTHER plasticizer in the Paraplex family has recently been announced by the Resinous Products & Chemical Co., Philadelphia, Pa. Known as Paraplex G-40, this new plasticizer is not subject to migration or extraction by aliphatic solvents, and becomes an integral part of the composition of the material it is compounded with. It is similar to Paraplex G-25, but shows a markedly improved solvent resistance, appreciable lighter color, lower viscosity at elevated temperature but slightly poorer low temperature flexibility. It is said to be of special interest to compounders of vinyl and synthetic rubber stocks and for other applications where the properties of a polymeric plasticizer are desirable. It is recommended for compounding specialty stocks such as those used for coated fabrics, unsupported sheeting, electrical jackets, adhesives and oil and heat resistant gasket stocks.

A new resin emulsion has also been announced by this company. Known as Emulsion G-25, it is an aqueous dispersion of Paraplex G-25 and is characterized by non-migration, permanence, resistance to heat and oil, and by flexibility at low temperatures. It is designed for use in plasticizing of buna N films and polyvinyl chloride latices such as Geon latex series used in the treatment of fibers and in the coatings of fabrics and paper. Emulsion G-25 is a white, medium to low viscosity fluid containing 48 to 52 percent solids, having a 9.0 to 9.5 pH and weighing approximately 8 lb. per gal. The emulsifying agent used in its

AN INTERMEDIATE
in dyestuff synthesis

ortho-Aminobiphenyl, Technical

(also known as 2-aminobiphenyl, ortho-aminodiphenyl, and 2-aminodiphenyl)



Mol. Wt. 169.22

STANDARD FORM: Cast Solid

SPECIFICATIONS:	
Purplish crystalline mass	
Crystallizing point	47.0°C. min.
Assay	94.5% min.
Distillation range First drop 95% (1-96 ml) Dry point	 295.0°C. min. 8.0°C. max. 310.0°C. max.

OTHER MONSANTO INTERMEDIATES

Benzene Sulfonic Acid, Technical
Benzoic Acid, Technical
Benzotrichloride
Benzyl Chloride
Cyclohexylamine
2,5-Dichloroaniline
2,4-Dichlorophenol
Dicydohexylamine
2,4-Dinitroaniline
2,4-Dinitrochlorobenzene
meta-Chloroaniline
meta-Nitrochlorobenzene
nitro-Dichlorobenzene
ortho-Aminobicyclohexyl, Refined
ortho-Anisidine
ortho-Chloroaniline
ortho-Chlorophenol
ortho-Nitroaniline
ortho-Nitrobiphenyl, Technical
ortho-Nitrochlorobenzene
ortho-Phenetidin
ortho-Vanillin (2-Hydroxy-3-Methoxy Benzaldehyde, Technical)
ortho-Veratraldehyde (2, 3-Dimethoxy Benzaldehyde, Technical)
para-Anisidine
para-Chloroaniline
para-Chlorophenol
para-Nitrochlorobenzene
para-Nitrophenol
para-Phenetidin
para-Toluenesulfonamide
para-Toluenesulfonyl-chloride
Phenol, U.S.P.
Phenol Sulfonic Acid, 65% and 70%
Phosphorous Oxychloride
Phosphorous Trichloride
Phthalyl Chloride
Salicylic Acid, Technical
Sodium Benzoate, Technical
Thiourea
Toluenesulfonic Acid, 94%

Used as an intermediate in dyestuff synthesis, Monsanto's ortho-Aminobiphenyl, Technical, also finds applications in the synthesis of rubber products. It is specifically used in making phenanthridine derivatives, quinoline yellow, and carbazole.

Samples will be promptly furnished for your experimental use. Contact the nearest Monsanto District Office, or write: MONSANTO CHEMICAL COMPANY, Organic Chemicals Division, 1700 South Second Street, St. Louis 4, Missouri. District Offices: New York, Chicago, Boston, Detroit, Cincinnati, Charlotte, Birmingham, Los Angeles, San Francisco, Seattle, Montreal, Toronto.

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FOR CONTROLLING air, water, gas, steam, light and heavy oils, and refrigerants, etc. Suitable for pressures up to 1,000 pounds and temperatures up to 400° F.

Internal valve assembly can be removed for cleaning and inspection if necessary. Two-wire—A.C. or D.C. —current failure—packless construction—bronze body—stainless steel and bronze internal parts—soft seats available.

SIX TIMES THE POWER of ordinary solenoid valves. This feature assures high seating pressure and overcomes the effect of viscous fluids, such as heavy fuel oil. Adequate power of the solenoid insures positive operation. Available in normally closed or open types.

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DISTRIBUTORS IN PRINCIPAL CITIES

24-3

manufacture is of the non-ionic type, producing an emulsion with enhanced stability toward electrolytes and an ability to be blended with other emulsions with safety, since the emulsifying agent is not precipitated by cation or anion active dispersing agents. Its general properties suggest a variety of applications wherever an aqueous dispersion of Paraplex G-25 is required.

COLORED ALUMINUM

It is now possible to dye aluminum metal in much the same manner as cloth fabrics are dyed by means of applying a special finish to the aluminum metal which renders it capable of being dyed. Developed by the Aluminum Co. of America, 230 Park Ave., New York, N. Y., aluminum objects are first treated in a special electrochemical bath and then dipped in a vat filled with dye. A wide variety of colors may be used.

THERMAL SETTING SILICONE RESINS

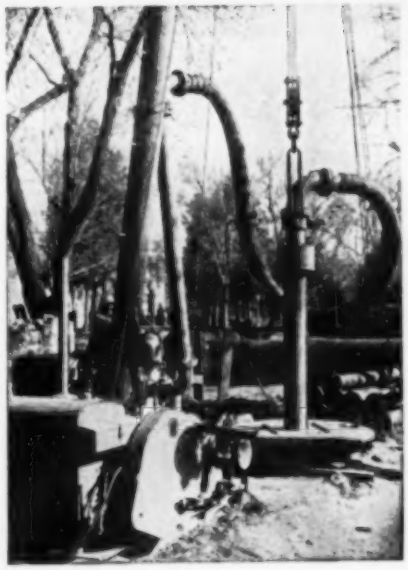
Another silicone resin product known as DC-804 is now available from the Dow Corning Corp., Midland, Mich. It was developed for use in the formation of hard, mar-resistant white finishes which are heat and weather resisting and which do not yellow with age. DC-804 is designed primarily for use in formulating heat resistant paints. It is similar to some of the other silicone resins and may be blended with some of them to produce finishes having various degrees of hardness and flexibility. It contains 50 percent resin by weight and is dissolved in toluene. It is straw colored with a density of 8.75 lb. per gal. Finishes formulated with this material do not become yellow with age because of the resistance of this resin to moisture, oxidation, ozone and ultraviolet radiations.

RUST INHIBITOR

Developed to prevent the formation of rust on ferrous metal parts during the interval between phases of manufacture, a new rust inhibitor known as Pennsalt RI-50, is commercially available. It is a white powder which is used in water solutions in a concentration of 2 to 4 percent by weight. Hot water solutions at 175 deg. F. or higher are recommended. Ferrous metal-parts are dipped into a bath where protection against rust is required between machining operations or for temporary storage prior to painting or other operations. Treatment with Pennsalt RI-50 should not immediately follow pickling or an acid dip. There should be an intervening rinse to remove any acid remaining on the parts. Alkaline cleaner film should be rinsed off with water prior to using this rust inhibitor. It is available in non-returnable drums of 25, 100 or 300 lb.

PROTECTIVE COATINGS

Two new protective coatings have recently been announced by the Truscon Laboratories, Inc., Caniff and Grand Trunk Railroad, Detroit 12, Mich. The first of these is a waterproof coating for rough porous walls and is known as Tite-Wall. This new material, which may be applied in the same manner as paint and other coatings, is



Builders of Modern
WELL WATER SYSTEMS

Layne Well Water Systems are absolutely modern in every detail—modern in the latest and most efficient engineering principles—modern in practical and economical design—and modern in rugged, long lasting construction. Furthermore, Layne Wells are drilled and completed by exclusive Layne developed methods which enable them to produce greater quantities of water per inch of casing diameter.

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Layne Well Water Systems have been the choice of cities, factories, refineries, railroads, irrigation projects, mines, etc., for nearly seventy years. Thousands are in use throughout the United States and in almost every foreign country on the globe.

For further facts, details, catalogs, bulletins, etc., address Layne & Bowler, Inc., General Offices, Memphis 8, Tenn.

HIGHEST EFFICIENCY

Layne Vertical Turbine pumps are available in sizes to produce from 40 to 16,000 gallons of water per minute. High efficiency saves hundreds of dollars on power cost per year.

AFFILIATED COMPANIES: Layne-Arkansas Co., Stuttgart, Ark. • Layne-Atlantic Co., Norfolk, Va. • Layne-Central Co., Memphis, Tenn. • Layne-Northern Co., Mishawaka, Ind. • Layne-Louisiana Co., Lake Charles, La. • Louisiana Well Co., Monroe, La. • Layne-New York Co., New York City • Layne-Northwest Co., Milwaukee, Wis. • Layne-Ohio Co., Columbus, Ohio • Layne-Texas Co., Houston, Texas • Layne-Western Co., Kansas City, Mo. • Layne-Western Co. of Minnesota, Minneapolis, Minn. • International Water Supply Ltd., London, Ontario, Canada • Layne-Hispano Americana, S. A., Mexico, D. F.

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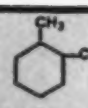
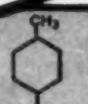
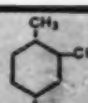
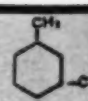
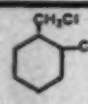
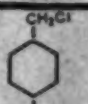
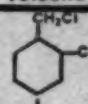
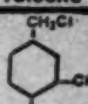
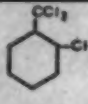
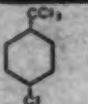
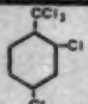
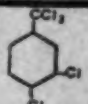
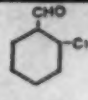
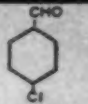
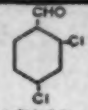
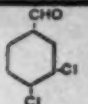
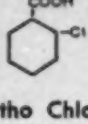
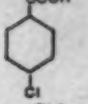
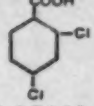
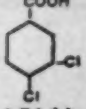
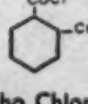
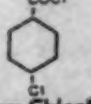
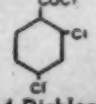
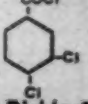
VERTICAL TURBINE PUMPS

New Chlorinated Intermediates by HEYDEN

FINE HEYDEN CHEMICALS

Chlorinated TOLUENES	 Ortho Chlor Toluene	 Para Chlor Toluene	 2,4-Dichlor Toluene	 3,4-Dichlor Toluene
Chlorinated BENZYL CHLORIDES	 Ortho Chlor Benzyl Chloride	 Para Chlor Benzyl Chloride	 2,4-Dichlor Benzyl Chloride	 3,4-Dichlor Benzyl Chloride
Chlorinated BENZOTRICHLORIDES	 Ortho Chlor Benzotrichloride	 Para Chlor Benzotrichloride	 2,4-Dichlor Benzotrichloride	 3,4-Dichlor Benzotrichloride
Chlorinated BENZALDEHYDES	 Ortho Chlor Benzaldehyde	 Para Chlor Benzaldehyde	 2,4-Dichlor* Benzaldehyde	 3,4-Dichlor* Benzaldehyde
Chlorinated BENZOIC ACIDS	 Ortho Chlor Benzoic Acid	 Para Chlor Benzoic Acid	 2,4-Dichlor Benzoic Acid	 3,4-Dichlor Benzoic Acid
Chlorinated BENZOYL CHLORIDES	 Ortho Chlor* Benzoyl Chloride	 Para Chlor* Benzoyl Chloride	 2,4-Dichlor* Benzoyl Chloride	 3,4-Dichlor* Benzoyl Chloride

Heyden presents a group of fine chemicals for use as intermediates in the manufacture of dyes and pharmaceuticals, and for the synthesis of other organic chemicals.

The chlorinated compounds shown above, recently developed by the Heyden Chemical Corporation, maintain the uniformly high quality of other Heyden chemicals. Their varied characteristics and properties indicate potentialities for new industrial uses.

All products shown above are available in commercial quantities, except those marked with an asterisk which are available in limited quantities for research use.

FINE HEYDEN CHEMICALS

HEYDEN *Chemical Corporation*

393 SEVENTH AVENUE, NEW YORK 1, N. Y.

Chicago Sales Office: 180 N. Wacker Drive, Chicago 6, Ill.

Benzaldehyde • Benzoates • Benzoic Acid • Benzyl Chloride • Bromides • Chlorinated Aromatics • Medicinal Creosotes • Formates • Formaldehyde • Formic Acid
Glycerophosphates • Medicinal Guaiacols • Hexamethylenetetramine • Parahydroxybenzoates • Penicillin • Pentaerythritols • Salicylates

Every WORKING PART Renewable

Yes, it's true . . . if the time should ever come that you needed to repair your CASH-ACME Type "B" you will find that *EVERY* Working Part is easily Renewable.

Just unscrew the Brass Bottom Plug and with a Hexagon Socket wrench remove the Piston-Cylinder Assembly from the body . . . screw in the new replacement unit and you are again ready for operation . . . WITHOUT EVER REMOVING THE VALVE FROM THE LINE.

RESULT . . .

Lower maintenance costs and less worries.

Write today for YOUR copy of our 28 page Catalog describing how CASH-ACME products can best serve you.

In Automatic VALVES its *This* NAME that COUNTS

CASH-ACME

A.W. CASH VALVE MFG. CORP.

WABASH and MORGAN

P. O. BOX 247

DECATUR ILLINOIS

claimed to seal rough porous surfaces such as cinder block against moisture penetration. Two coats of this material are claimed to waterproof cinder block or concrete walls. It is available in 1-gal. and 6-gal. containers and is produced in white and several colors.

The second of these coatings, known as Paratex, is a rubber base paint for use on various surfaces such as concrete, wood, metal and canvas. It is claimed to be resistant to acids, alkalis as well as being water resistant.

SARAN FABRICS

WATER RESISTANT fabrics are now woven of Saran monofilaments which are extruded in both transparent and opaque types by the Dow Chemical Co., Midland, Mich. Pigments and dyes are added to the fine molding powder before extrusion to produce various colored filaments. These fabrics have the same resistant qualities as other Saran products. The monofilaments range in size from 0.003 to 0.053 in. in diameter and should not be confused with fine multifilaments or other synthetic materials used in dress goods and hosiery. These monofilaments produce a strong smooth surfaced rather stiff fabric which will not stain or fade under ordinary usage.

ALUMINUM ROOF PAINT

DEVELOPED by the United Gilsonite Laboratories, Scranton 1, Pa., a new aluminum roof paint is said to form a reflecting protective covering which provides longer life for the surface and reduces inside temperatures by as much as 15 deg. F. It is processed from an asphalt base and fortified with a pure aluminum paint. When the paint is applied, the aluminum pigment "leafs" to the surface to form a foil-like metallic shield. The brightness or reflectivity of this aluminum shield is claimed to reflect 80 percent of the sun's rays. It is suitable for use on slate roll roofing asphalt shingles, built up, slag or metal roofs. It may also be used for any outdoor metal work such as tanks, iron fences, etc. One coat of this aluminum roof paint is claimed to be satisfactory for most jobs. It has a coverage of 300 to 350 sq.ft. per gal. at a cost of about 1c. per sq.ft. It is packaged ready to use in 1-qt., 1-gal. and 5-gal. containers. It requires no thinner, no mixing, and may be applied with a paint brush or spray gun. It is claimed to dry within one hour after application.

GERMAN INSECTICIDE

CAPABLE of destroying certain insects against which DDT is not effective, a new insecticide, the formula of which was learned by United States scientific field teams from German chemists, is now being produced by the Monsanto Chemical Co., St. Louis 4, Mo. This new insecticide, hexaethyl tetraphosphate, is effective against aphids and mites which feed on foliage and are most commonly found in orchards, as well as in vegetable and flower gardens. It is a supplement to nicotine sulphate normally used in this country as an aphid and mite destroyer. However, present supplies of nicotine are not sufficient for the present needs. This new insecticide, a light tan colored liquid, is claimed to be superior to nicotine in some

NEW DE-IONIZER for LABORATORIES and small industrial plants

REMOVES TROUBLESOME DISSOLVED MINERALS FROM YOUR WATER SUPPLY

√ CONVENIENTLY
√ EFFICIENTLY
√ ECONOMICALLY

- Produces De-ionized water (the modern low-cost equivalent of distilled water)
- 200 gallons on 7 grain water for less than 20¢
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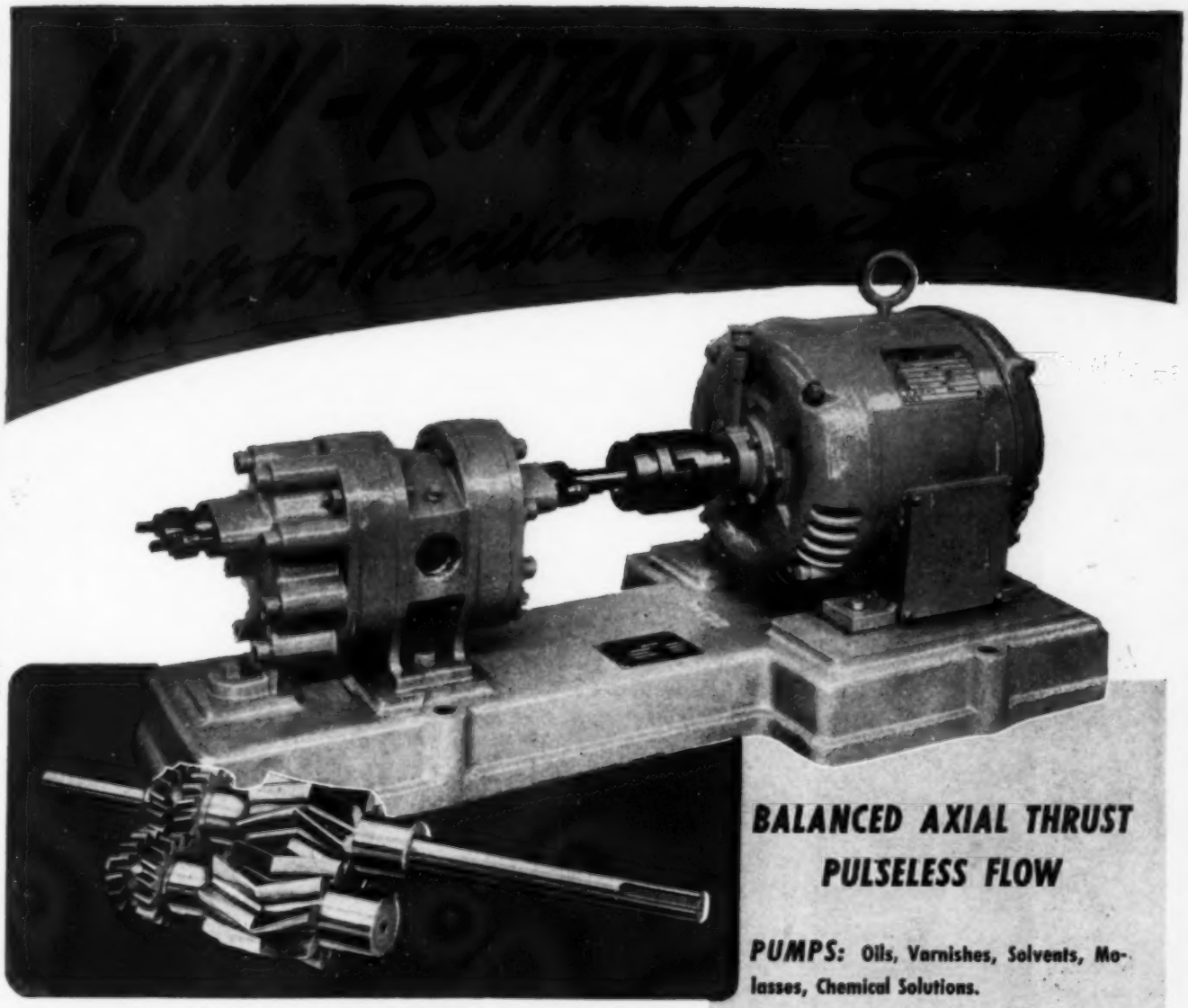
WATER TREATMENT ENGINEERING

TESTED IN THE LABORATORY · PROVED IN THE FIELD · ILLCO-WAY

See this equipment at the Chemical Exposition, Chicago



The Sier-Bath GEAREX Runs Quieter, Lasts Longer Because of Minimum T.A.E.

● Why should longer life and quieter operation result from cutting the rotating parts of the Sier-Bath Gearex Pump to minimum T.A.E. (Total Accumulated Error)? Because this precision fabricating virtually eliminates timing gear impact loads and stress concentrations. It assures the maintenance of accurate rotor clearance. Thus, it helps maintain high efficiency throughout the Sier-Bath GEAREX Pump's long service life.

In other respects, too, this pump is unique. It provides a pulseless uninterrupted discharge and its rotors are *not in contact*. Deep-toothed, small in diameter, their low pitch line speeds result in efficient, quiet operation not found in the conventional type gear pumps. Their special design prevents trapping. Sier-Bath GEAREX Pumps are equipped with roller bushings for precision running under load.

They are available in horizontal and vertical models, internal and external bearing types, in steel or special alloys, and with jacketed bodies for high temperature applications or where heat must be applied. Write for detailed information.

BALANCED AXIAL THRUST
PULSELESS FLOW

PUMPS: Oils, Varnishes, Solvents, Molasses, Chemical Solutions.

CAPACITIES: 1 to 550 G. P. M.

DISCHARGE: 250 p.s.i. for medium or high viscosities. 50 p.s.i. for water.

★

For Higher Pressures and Capacities Use

SIER-BATH SCREW PUMPS

SIER-BATH GEAR COMPANY, INC.
[illegible] HUDSON BOULEVARD • NORTH BERGEN, NEW JERSEY

FOUNDED 1905 • MEMBER OF A. G. M. A.

Sier-Bath Gear Co. Inc.

WIRE MESH PARTS

FILTERS, STRAINERS, AND OTHER WIRE-MESH ASSEMBLIES

In all sizes of mesh and in shapes to your order from wire mesh of brass bronze steel nickel tungsten monel molybdenum and other metals and special alloys

Every operation, from wire drawing and weaving to fabricating in the finished part is done in the Jelliff mill.

OTHER JELLIFF PRODUCTS

- ★ Jelliff Fine Resistance Wire
- ★ Jelliff Dipping Baskets
- ★ Jelliff Wire Cloth
- ★ LEKTROMESH

THE C. O. JELLIFF MFG. CORP.
Pequot Road
Southport, Connecticut

respects. Hexaethyl tetraphosphate is a contact insecticide, and although it has not been thoroughly tested, it is believed that it will be found of value in the control of a wider number of insect pests. It will be formulated by insecticide manufacturers for use as a spray or dust.

PLASTIC SHEETING

A PLIABLE, tough and washable plastic sheeting for use in handbags, purses, belts, billfolds, tobacco pouches, briefcases, etc., is now being produced by the United States Rubber Co., Rockefeller Center, New York, N. Y. Known as U. S. Royalene, the sheeting is made without fabric backing or surface finishing coats. It is claimed not to harden or crack with age or severe use and is pliable and can be easily tailored into wrinkle-free finished products. It is waterproof and can be cleaned with soap and water. It is dustproof and has good resistance to snagging, tearing or puncturing and has a high stain resistance. U. S. Royalene is claimed not to be affected by alcohol, perspiration, oil, grease, mildew and most acids. It is available in a range of colors from light to dark tones and in several gages and pliabilities, depending on the requirements for the end product.

GEAR LUBRICANT

COMPOSED of a specially compounded soap with sulphur, chlorine, phosphorus, and additives, a new gear lubricant has recently been developed by the Texas Co., 135 E. 42nd St., New York, N. Y. Known as Texaco Universal, this lubricant is a balanced mixture of highly active anti-weld agents and a less reactive film strength or surface active agent. It has good stability, is non-foaming, non-channeling and non-corrosive when subjected to water. It is claimed to provide increased protection for heavily loaded hypoid gears and is designed to protect gears subjected to high torque, low speed conditions and to withstand high speed shock loading. It is said not to rust metal or cause the formation of sludge and gummy deposits.

UPHOLSTERY FABRIC

DESIGNED to meet the requirements of the upholstery field, a new fabric is now being produced by the Athol Mfg. Co., Athol, Mass. It is an addition to the Terson line of fabrics consisting of a synthetic resin plastic coating applied to a woven fiber base of heavy cotton. The dispersion of synthetic resins is then baked on by means of infrared lamps to form a product with good flexibility and long life. It is claimed to be waterproof, slow burning and can be made mildew proof and fireproof, if required. It is flexible and can be cleaned easily with a damp cloth. It is available in popular colors.

SENSITIZED PAPER

BY USE of the new Weiline sensitized papers, it is claimed that positive prints can be made direct from engineering drawings and tracings without the use of a negative. This development of J. H. Weil & Co., 1315 Cherry St., Philadelphia, Pa., uses a dry direct process of development, enabling blue, red or sepia prints to be obtained in colored lines on a white background.

CASE HISTORY No. 6

One in a series of factual experiences of a group of American manufacturers with Multiwall Paper Bags.

COST COMPARISON

(Computed from cost figures of year 1943 using 25 acre production as average per harvesting unit per 12 hour day and an average barley yield of 20 bags an acre.)

	100 Lb. Jute Bags	100 Lb. Sewn Multiwall Paper Valve Bags
Bag Cost per M	$245.00	$87.18
Bag Cost	.245	.0871
Bag Cost Per Acre (20 bags per acre)	4.90	1.7420
Labor Cost Per Acre	1.65	.7332
Total Bag and Labor Cost Per Acre	$ 6.55	$ 2.4752
Saving Per Acre Paper Over Jute		4.07

DETAILS OF LABOR COSTS

Jute Bags	Per Day
1 Harvester Operator	6.50
1 Swamper (Filling and preparing bags for sewing)	4.00
2 Sack Sewers at $5.50	$11.00
1 Tractor Driver	4.75
Sack Bucking (at $.60 per acre)	15.00
(Picking up scattered sacks from field) Total Labor Cost Per Harvester	$41.25
Labor Cost Per Acre Jute Bags	$ 1.65

Multiwall Paper Valve Bags	Per Day
1 Harvester Operator	$ 6.50
⅓ Truck Driver (Transports bulk trailers for 3 harvesters) at $4.75	1.58
1 Man Packing	5.50
1 Tractor Driver	4.75
Total Labor Cost Per Harvester	$18.33
Labor Cost Per Acre Paper Bags	.7332

1946 Crop (Estimated)

3,500 Acres Wheat
3,100 Acres Flax
6,600 Acres Total

$4.07 Saving per acre paper over jute

$26,862 Total saving paper over jute 1946 crop.

BICARBONATE OF SODA OYSTER SHELL GRITS DOG FOOD CALCIUM CHLORIDE LIME MOULDING POWDERS CLEANING COMPOUNDS FLOUR INSECTICIDES QUICKLIME FULLER'S SUGAR FERTILIZERS COTTONSEED MEAL BICARBONATE OF SODA TALC SUGAR CEREALS PLASTER ANIMAL FEEDS ASPHALT

ANOTHER RECORD IN ST. REGIS PACKAGING EFFICIENCY AND FLEXIBILITY

ALFALFA MEAL OYSTER SHELL GRITS SYNTHETIC RESINS MILK, DRY SOYA BEAN FLOUR RUBBER, SYNTHETIC INSECTICIDES SODA ASH SALT SALT CALCIUM CHLORIDE POULTRY FEED STARCH ROSIN RICE QUICKLIME PLASTER FULLER'S EARTH PEANUTS CEMENT MILK, DRY, POWD CEREALS

California Grain Grower Saves $4.07 Per Acre with Multiwalls

This sixth in a series of Multiwall Case Histories tells how Murietta Farms in California made drastic savings in the packaging of barley, wheat and flax by changing over to St. Regis Multiwall Paper Valve Bags and Machine Packaging.

When jute bags became scarce in 1942, Mr. Giffen, operator of Murietta Farms, investigated the advantages and economies of Multiwall Bags and installed a St. Regis system tailor-made for his requirements — *here are the highlights:*

66⅔% SAVING IN BAG COSTS: Multiwalls cost only 8½¢ each as contrasted with 24½¢ for burlap bags. In addition, Multiwalls, with their multiple layers of tough kraft paper, offered positive protection against the elements.

56% SAVING IN LABOR COSTS: By installing gravity-type packers and using Multiwall Paper Valve Bags, it was possible to eliminate the men formerly required to sew fabric sacks. In addition, the system made it possible to fill the bags at a central spot . . . eliminating the tiresome and costly collecting of sacks scattered over the fields.

MULTIWALLS SAVE CROP STORED IN OPEN FOR 6 MONTHS: During the harvesting seasons of 1944 and 1945, it was necessary to leave the filled Multiwall bags in the open for six months . . . from the end of harvesting until late in November. The grain in the Multiwalls remained in perfect condition. Mr. Giffen estimates that between ⅓ and ½ of the crop would have been lost through exposure if the grain had been packed in burlap.

EVEN GREATER SAVINGS IN '46: Figures for the 1946 crop indicate that Mr. Giffen will effect a saving of approximately $26,862. This is based on an average saving of $4.07 per acre through the use of paper instead of jute in the packaging of 3,500 acres of wheat and 3,100 acres of flax.

Multiwall Paper Valve Bags being filled from spouts on trailer.

Filled bags stacked at edge of field; no protection against the elements supplied or required.

MULTIWALL

ST. REGIS SALES CORPORATION

(Sales Subsidiary of St. Regis Paper Company)

NEW YORK 17: 230 Park Ave. CHICAGO 1: 230 No. Michigan Ave.
BALTIMORE 2: 2601 O'Sullivan Bldg. SAN FRANCISCO 4: 1 Montgomery St.

Birmingham Boston Cleveland Dallas Denver Detroit
Franklin, Va. Los Angeles Nazareth, Pa. New Orleans
No. Kansas City, Mo. Orela, Fla. Oswego, N. Y. Seattle Toledo

IN CANADA: St. Regis Paper Co. (Can.) Ltd., Montreal, Vancouver.

Without obligation, please send me full details regarding "Case History" No. 6, outlined above.

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COMPANY_____

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EQUIPMENT SERVICED BY HILCO in the Chemical Industry includes:

★ **VACUUM PUMPS**—lubricating and sealing oil maintained free from grit, sludge, acid, moisture and dissolved gases.

★ **COMPRESSORS** – kept free from carbon and varnish deposits.

★ **DIESEL ENGINES** – lube oil constantly kept in condition of new oil, greatly extending engine life; fuel oil filtered, promoting combustion efficiency.

★ **TRANSFORMERS** – insulating oil fully desludged, neutralized, dehydrated and deaerated without taking transformers out of service.

Oil is purified after each pass through pump.

★

THE HILCO OIL RECLAIMER is a miniature refinery which by continuous operation removes oil contaminants from a lube system as fast as they are formed or introduced, thus maintaining the oil at new oil specifications.

★

PROTECT YOUR INVESTMENT in process equipment by keeping the lubricating systems clean. HILCO equipment is available to take care of all types of oil purifying problems.

THE HILLIARD CORPORATION

131 W. Fourth St., ELMIRA, N. Y.

WRITE TO-DAY! FOR FREE INFORMATION

THE HILLIARD Corporation

ELMIRA. N. Y.

PLEASE SEND YOUR BULLETIN NO. 95

NAME_____

COMPANY_____

STREET_____

CITY_____ STATE_____

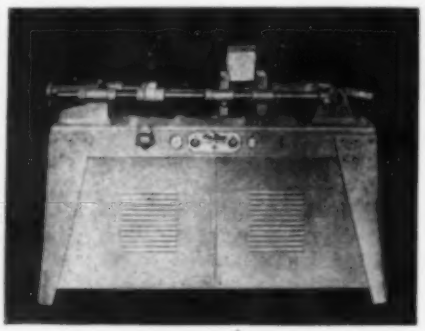
EQUIPMENT NEWS

(Continued from page 144)

195 San Bruno Ave., San Francisco, Calif. This material, a powder, is blown into a furnace while it is in regular operation, forming a dense, non-poisonous vapor which reaches all parts of the installation. The material is claimed to break hard combustion deposits down into a soft powder which is mostly carried up the stack by the draft. It is also claimed to exert a corrosion retarding effect on the metal parts.

INJECTION PRESS

A CAPACITY of 1 oz. is available in a new small power-operated plastic injection molding press, known as Model H-200, that is offered by Van Dorn Iron Works Co., 2685 East 79th St., Cleveland 4, Ohio. The unit has been simplified for easy operation in production, research and instruction use. Power for production, plunger injection and



1-oz. injection molding press

mold closing is secured by hydraulic cylinders. A 2-hp. electric motor operates a gear type pump which develops up to 1,500 lb. line pressure. Automatic parts injection is provided as well as automatic temperature control in two zones which are maintained by individual thermostats within plus or minus 6 deg. F.

DOOR OPERATOR

AUTOMATIC operation of single sliding doors with level or inclined track is possible with a new pneumatic operator announced by National Pneumatic Co., 420 Lexington Ave., New York 17, N. Y. These operators are supplied in packaged kits suitable either for newly installed doors or those already in service. A set consists of several standardized units including the door operator, wall brackets, the operating arm, and the door slide. Sets are available for several different door widths. Operating speed is pre-set at

Pneumatic operator for sliding doors

PLATE AND SHEET STEEL PRODUCTS

If it's a tank, guard, base or special metal part for a new machine or to replace a worn out unit, Littleford is equipped to make the most intricate of fabricated steel products. Whether it's to be made from plain steel or alloy metals it can be formed and welded to the exact detail. It's no problem to get special fabricated metal parts, let Littleford be your source of supply, even if it's for one unit or many — send blueprints for estimate of cost.

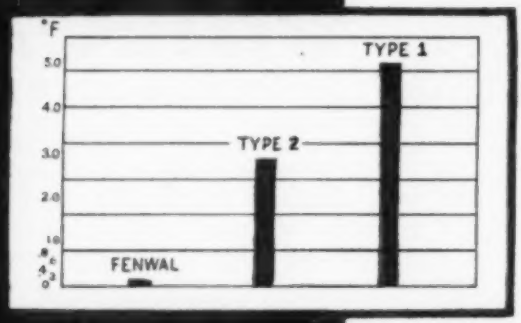
LITTLEFORD

LITTLEFORD BROS., INC.
428 E. Pearl St., Cincinnati 2, Ohio.

SMALL TEMPERATURE DIFFERENTIAL*

You can't have close control of temperature if the controlling thermostat has a large operating temperature differential. Fenwal THERMOSWITCH Controls have an inherent minimal temperature differential which reduces temperature overshoot and undershoot effects. This small temperature differential can be increased to suit your requirements by proper THERMOSWITCH Control application.

Chart shows the small operating temperature differential of the Fenwal THERMOSWITCH Control compared to Type 1 and Type 2 thermostats. The force exerted by the expansion and contraction of the temperature sensitive brass shell is transmitted directly through the two anchored ends of the contact support members causing a positive make or break of the electrical contacts resulting in accurate temperature control.



Compact and easily installed, Fenwal THERMOSWITCH Controls have proven themselves in thousands of applications under all conditions. Investigate the advantages of THERMOSWITCH Controls as applied to your heat control problem. Send for your copy of the Thermotechnics Booklet which includes the "Fourteen Facts in Fenwal's Favor."

* #4 of the "Fourteen Facts in Fenwal's Favor".

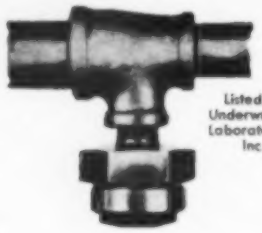
Fenwal

FENWAL INCORPORATED

53 PLEASANT STREET

ASHLAND MASSACHUSETTS

THERMOTECHNICS FOR COMPLETE TEMPERATURE REGULATION



Listed by Underwriters Laboratories, Inc.

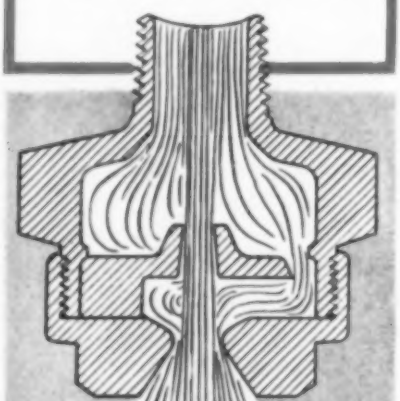
This is how the

BLAW-KNOX

Aquatomic

FOG NOZZLE

FIGHTS FIRE



IN TRANSFORMERS, FLAMMABLE LIQUIDS AND STORAGE TANKS

The *Aquatomic Fog Nozzle* creates a cone of atomized water particles having force enough to reach to the base of the fire in spite of air turbulence and drafts.

At the same time, these particles are fine enough to give a maximum cooling and quenching effect, and are so well separated as to prevent conduction of electric currents.

The spray pattern is maintained even with reduced pressures. Clear passages in the nozzle prevent clogging.

Also—

Standard Wet and Dry Pipe Systems, as well as Thermostatically Controlled Pre-Action and Deluge Systems.

Write for details

BLAW-KNOX

SPRINKLER DIVISION

831 Beaver Avenue, N. S.,
Pittsburgh 12, Penna.

the factory but the operator is equipped with a speed adjustment to suit special conditions. Various types of remote controls are available to open doors without delay for the passage of trucks or personnel. If desired several different door operators may be suitably interlocked for fire protection or to take care of other special conditions or hazards. This equipment is designed to operate on pressures from 80 to 100 lb.

CHEMICAL ROTAMETER

To ENABLE corrosive liquids and gases requiring special piping materials to be metered, Schutte & Koerting, Philadelphia, Pa., has introduced a new chemical rotameter designed so that the metered fluid comes in contact only with the required special material and with the Pyrex metering tube. Such special materials include Haveg, Karbate, Pyrex, porcelain, hard rubber, and corrosion resisting metals. Construction features of this company's standard rotameters, such as the use of a sturdy metal frame and an easily removed tube assembly, are retained. Special means are employed to assure ample support against stresses in the piping, and thermal shock, in cases where fragile materials are used. These meters are equipped with special corrosion resisting rotors, suitable for the fluid being handled.

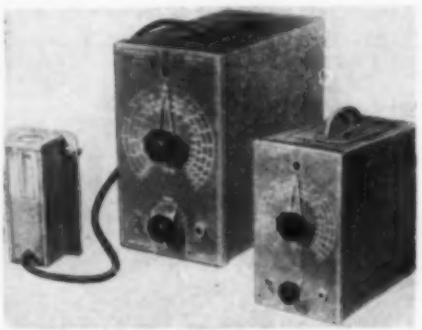
ELECTRIC HYDROMETER

FIRST SHOWN at the Chemical Exposition, the new Aminco- Dunmore electric hygrometer has been announced by the American Instrument Co., Silver Spring, Md. The new instrument employs a sensing element claimed to be the fastest device known for measuring humidity changes. The hygrometer is said to give reproducible readings throughout the entire standard temperature range of 40 to 120 deg. F. and the relative humidity range of 7 to 100 percent. Changes within plus or minus 0.5 percent relative humidity can be sensed instantly, it is claimed, and indicated or recorded within the standard temperature range.

PORTABLE STROBOSCOPE

MODEL 1210 is the designation of a newly developed stroboscope produced by Communication Measurement Laboratory, 120 Greenwich St., New York 6, N. Y. The device uses a novel electronic circuit, with a self-blocking oscillator, and is employed to "stop" rotary or vibratory motions when the moving object is examined with the stroboscopic light source. The speed covered is from 600 to 48,000 r.p.m., in four ranges. A synchronized reed is provided for accurate calibration against the line fre-

Stroboscope for speeds to 48,000 r.p.m.



IF YOU HAVE A FEEDING PROBLEM

Install

OMEGA

CHEMICAL FEEDERS

Don't pussy-foot around that chemical feeding problem... go straight to Omega! Omega Feeders have solved the chemical feeding problems of many industries. Their accuracy and dependability bring new uniformity to processing operations with real savings in production time and chemicals. A group of Omega Feeders with interlocked control positively assures the accurate proportioning of several ingredients as required by process. Whatever your chemical feeding problem, Omega can solve it! Ask our engineers for recommendations.

Omega Rotodip Feeder handles chemical solutions — oils, extracts, acids, etc. Feeds continuously with an accuracy of ± 1% and the rate is instantly adjustable over a 100 to 1 range. Capacity 1 to 800 g.p.h.

OMEGA PRODUCTS

Volumetric Dry and Solution Feeders
Gravimetric Feeders
Lime Slaking Equipment

Write for descriptive bulletins.

OMEGA MACHINE CO.

(Division of Builders Iron Foundry)

29 Codding Street, Providence 1, R. I.

More New Fluorine Compounds by General Chemical

POTASSIUM
KF • HF
BIFLUORIDE

POTASSIUM
KF • 3HF
POLYACID
FLUORIDE

SOME POTENTIAL USES:

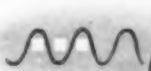
HEAT TREATING—Means of controlling the melting point of heat-treating salts.

GLASS—In etching glass or other silicon-bearing products. As "frosting" agents.

CERAMICS—As opacifiers. As materials to increase the fluidity and alter the melting point of the mix.

CHEMICAL PROCESSING Source of HF in dry form. For preparation of elemental fluorine by electrolysis.

ELECTRONICS—Special medium for etching quartz crystals.



MINING—Agents for digestion of insoluble ores.

METALLURGY—As ingredients in fluxes and pastes for welding, brazing or soldering. For surface preparation of aluminum and stainless steel before spot welding.

General Chemical Fluorine Research announces Potassium Bifluoride and Potassium Polyacid Fluoride to American Industry. These are versatile, reactive products whose properties indicate varied applications. For example, consider their potentialities in the fields suggested here.

Perhaps such uses point to a place for either Potassium Bifluoride or Potassium Polyacid Fluoride in *your* development or production program. Experimental samples are available from General Chemical Company, Fluorine Division, 40 Rector Street, New York 6, N. Y., or through the nearest Sales and Technical Service Office.

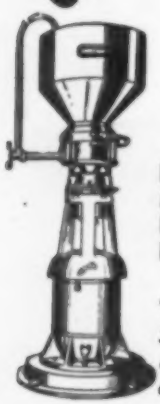
When writing for the information you need, why not outline your proposed uses for these products? This way the technical experts of our Fluorine Division can work with you toward an early solution of your problem.

BASIC CHEMICALS
GENERAL CHEMICAL COMPANY
FOR AMERICAN INDUSTRY

GENERAL CHEMICAL COMPANY
40 RECTOR STREET • NEW YORK 6, N. Y.

Sales and Technical Service Offices: Atlanta • Baltimore • Birmingham Boston • Bridgeport • Buffalo • Charlotte • Chicago • Cleveland Denver • Detroit • Houston • Kansas City • Los Angeles • Minneapolis New York • Philadelphia • Pittsburgh • Providence • San Francisco Seattle • St. Louis • Utica • Wenatchee (Wash.) • Yakima (Wash.)
In Wisconsin: General Chemical Wisconsin Corporation, Milwaukee, Wis.
In Canada: The Nichols Chemical Company, Limited Montreal • Toronto • Vancouver

HAVE YOU HEARD HOW THIS MILL CAN HELP YOU?



FINER GRINDING, MORE UNIFORM DISPERSIONS RESULT IN BETTER PRODUCTS

The Eppenbach *High Speed Wet Grinding and Colloid Mill* is a dual purpose machine:

1. It reduces particles to sub-micro-dimensions by grinding, and
2. Effects perfect dispersion of such particles into fluid or plastic materials.

An examination of the turbine design shows why it is possible for a single machine to perform these two distinct operations. Liquid is broken up into minute globules by high velocity impact at top of turbine. Suspended material is mechanically sheared by the rotor and stator teeth, and hydraulically sheared by the final smooth surfaces of rotor and stator.

Eppenbach Mills are available in laboratory and production sizes. Capacities range from ½ to 3600 gallons per hour or higher.

Write for complete details. Ask for a copy of Catalog No. 401.

EPPENBACH, INC.
45-10 VERNON BOULEVARD
LONG ISLAND CITY 1, N. Y.

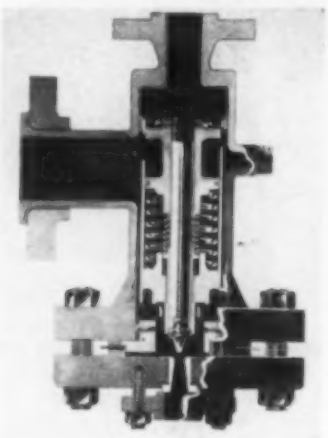
Eppenbach

quency. All four scales are easily and quickly calibrated within plus or minus 3 percent.

The device is intended primarily for slow-motion study of rotating, reciprocating or vibratory mechanisms. For example, in the rayon industry it can be used in observing the action of spinning buckets and twisters. The stroboscopic light may be used in small, out-of-the-way places, since it is contained in a probe attached to a 4-ft. flexible cable. The light probe and cable are housed in the cabinet when the stroboscope is not in use. The instrument weighs only 19¼ lb.

PUMP RECIRCULATOR

PROTECTION of centrifugal pumps against failure due to insufficient flow of liquid, which would cause overheating and destruction of the pump, is the function of a new recirculator valve offered by Hammel-Dahl Co., 243 Richmond St., Providence 3, R. I.



Automatic recirculating valve for centrifugal pumps

Such insufficient flow may arise from failure of fixed recirculating orifices, failure of the prime mover to drive the pump at sufficiently high speed, or restrictions in the discharge piping. The new valve is operated from the fluid flow and designed to bypass the minimum quantity of fluid required to eliminate pump overheating. As the quantity of fluid passing through the pump increases, the bypassed quantity is automatically throttled and is reduced to zero when the output of the pump is sufficient to prevent pump failure. The valve may be installed in existing pump piping merely by removing any convenient elbow in the discharge piping upstream of all checks and stops. When there is little or no flow to the pump, the bypass is wide open. When the discharge rate starts to increase, the plug in the recirculator valve approaches its seat, decreasing the quantity of fluid recirculated until with sufficient flow the bypass closes tight. On decreasing flows, the above cycle is reversed.

PADDLE PUMP

LOW PRICE for a ¾ in. pump is found in the Simer Paddle Pump manufactured by Jerome Simer Co., 422-L Stinson Blvd., Minneapolis 13, Minn. The pumping element consists of a multi-vaned rotor of tire-tread rubber, placed eccentrically within a cylindrical casing. Rotation causes pumping action through progressive flexing of the vanes toward and away from the rotation center. The pump operates at speeds up

CHASE LINERS

* Stop Liner Breakage!
* Stretch in All Directions!

Chase Liners are better, more resilient, more flexible! Here's why: they're crinkled for vertical elasticity *and* pleated for horizontal elasticity! Result: no more broken liners nor costly damage to contents due to liner failure or breakage.

Check on Chase Liners today. They're the crinkled and pleated liners that assure savings . . . that actually cost no more!

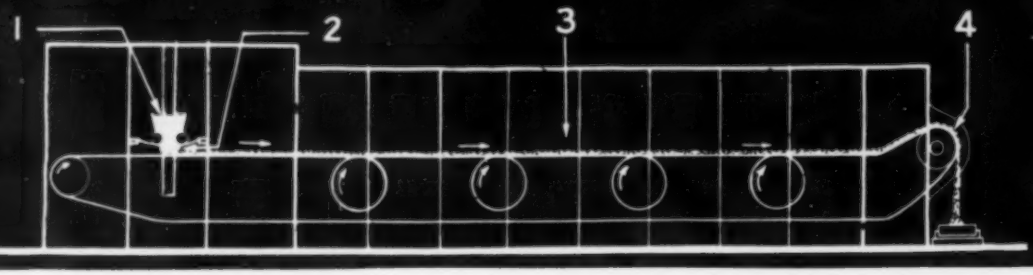
CHASE BAG CO.

GENERAL SALES OFFICES
309 WEST JACKSON BLVD., CHICAGO 6, ILL.

BOISE • DALLAS • TOLEDO • DENVER • DETROIT • MINNEAPOLIS ST. LOUIS • NEW YORK • CLEVELAND • MILWAUKEE • PITTSBURGH BUFFALO • KANSAS CITY • MEMPHIS • GOSHEN, IND. • PHILADELPHIA NEW ORLEANS • ORLANDO, FLA. • SALT LAKE CITY • OKLAHOMA CITY • PORTLAND, ORE. • REIDSVILLE, N. C. • HARLINGEN, TEXAS CHAGRIN FALLS, O. • HUTCHINSON, KAN. • WINTER HAVEN, FLA.

CLOSE CONTROL and INCREASED OUTPUT ASSURED IN PRODUCTION OF SULFA DRUGS WITH

CONTINUOUS CONVEYOR DRYER



1. Material is dewatered by means of a batch centrifuge and delivered to pre-forming feed of dryer.

2. Material is pre-formed into small extrusions by means of Proctor Rolling Extruder Feed, equipped with a special grid type of extruder plate. This particular type of plate is ideally suited to pre-forming the stiff cake of material as it comes from the centrifuge. Extrusions enter dryer with a moisture content of 105.5% (B.D.W.B.*).

3. Material is loaded to uniform depth of 3.5" on moving conveyor. Circulation of heated air is through bed of material on moving conveyor, promoting rapid, uniform drying.

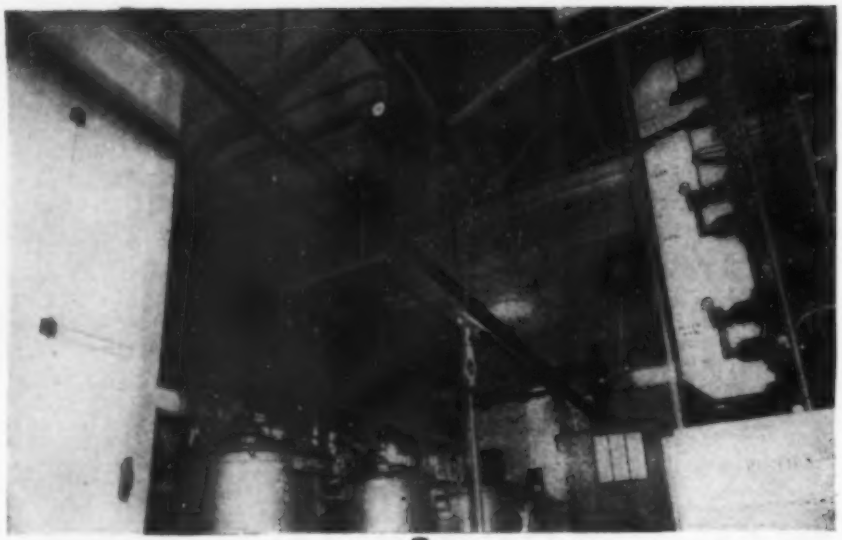
4. Material is dried to moisture content of 0.32% (B.D.W.B.) at rate of 400-425 lbs. (C.D.W.†) per hour.

*Bone Dry Weight Basis. †Commercial Dry Weight.

The problem of increasing the output of sulfa drugs to meet market demands and at the same time controlling the quality of the finished product, was one that was turned over to Proctor engineers for study. After considerable research into the subject they arrived at a solution—it was a Proctor continuous conveyor system with a rolling extruder feed. Preforming the wet-solid material into small extrusions permitted the circulation of heated air to pass readily all the way through the bed of material on a constantly moving conveyor. Combining the pre-forming with the principle of conveyor drying enabled output to be increased to meet the plant's requirements. The dryer itself was so designed that accurate control was exercised over temperatures, air circulation, speed of the conveyor and humidity in the drying enclosure. The net result—increased output of a product that met all tests for quality. This system is but one of many "tailor-made" systems which Proctor engineers have designed for the pharmaceutical industry. If you have a pharmaceutical drying problem, don't hesitate, write today, giving us as much information as possible about your problem.

Small extrusions, formed by a rolling extruder feed with a special grid type plate, permit through circulation of air. Rapid, uniform drying results.

P&S PROCTOR & SCHWARTZ · INC. · PHILADELPHIA 20 · PA.



REGULATED "Automatic" PROTECTION

AUTOMATIC FIRE-FOG

★ IT BLANKETS ★ IT ISOLATES ★ IT QUENCHES ★

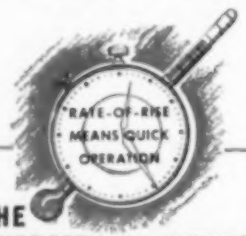
FOR VOLTAGE REGULATORS

Oil-filled electrical equipment such as transformers, voltage regulators, switches and the like demand regulated fire protection at all times.

These electrical installations are the work-horses of industry. Their failure can well spell the break-down in the continuity of plant production.

Far-sighted engineers are demanding "Automatic" FIRE-FOG protection for all types of flammable liquid fire hazards. They know well, the amazing effectiveness of this automatic . . . quick action fire quenching water spray and the results of this protection are written into the records of all leading Fire Insurance Bureaus.

Investigate the advantages of "Automatic" FIRE-FOG protection for your specific fire protection problem. There's no obligation.



THE SUPROTEX* SPRINKLER SYSTEM

—a famous member of the "Automatic Sprinkler Family. Designed particularly for use in manufacturing, mercantiles, warehouses, schools, churches, offices, hospitals, piers and other establishments where positive fire protection is essential.

*Trademark Registered U. S. Patent Office

"Automatic" Sprinkler

"AUTOMATIC" SPRINKLER CORPORATION OF AMERICA

YOUNGSTOWN, OHIO . . . . . OFFICES IN 37 CITIES

"Automatic" Sprinkler designs, manufactures and installs a complete line of fire protection devices and systems for all types of fire hazards. Listed by Underwriters' Laboratories, Inc., and approved by Factory Mutual Laboratories

to 1,750 r.p.m. and can be used at pressures up to 30 lb. (including a 20-ft. suction head). Oils, greases and chemicals that will not destroy bronze, stainless steel or the rubber composition used may be pumped.

INJECTION MOLDER

SELF-CONTAINED construction and fully hydraulic operation, secured by a vane-type pump, are featured in a new 1-oz. injection molding machine developed by Watson-Stillman Co., Roselle, N. J. The new machine is designed to relieve larger equipment of experimental work and to make molding from small, single-cavity dies more profitable on short runs. Control of the molding pressure up to a maximum of 1,200 lb. is handled steplessly by means of a microvalve. Positive alignment of the nozzle with the sprue opening in the die is provided through a dowel arrangement. Standard equipment includes thermostatic control of the heating cylinder, while an indicating temperature control is among the optional equipment available.

MULTIPLE CONTROLLER

FURTHUR flexibility in control is possible through the development of the Multronic Capacitrol, according to a recent announcement of Wheelco Instruments Co., 847 West Harrison St., Chicago, Ill. This multiposition electronic pyrometer controller employs two electronic control circuits without mechanical contact which operate in harmony with each other, but independently, to provide: (1) conventional on-off control at one or two different points; (2) control of two separate fuel systems on a single furnace; (3) automatic positioning control for electric, oil or gas-fired equipment; (4) on-off control plus automatic fuel shut-off; or (5) multi-signalling at two points or two signals at dual points. Instantaneous control action is said to be secured.

EQUIPMENT BRIEFS

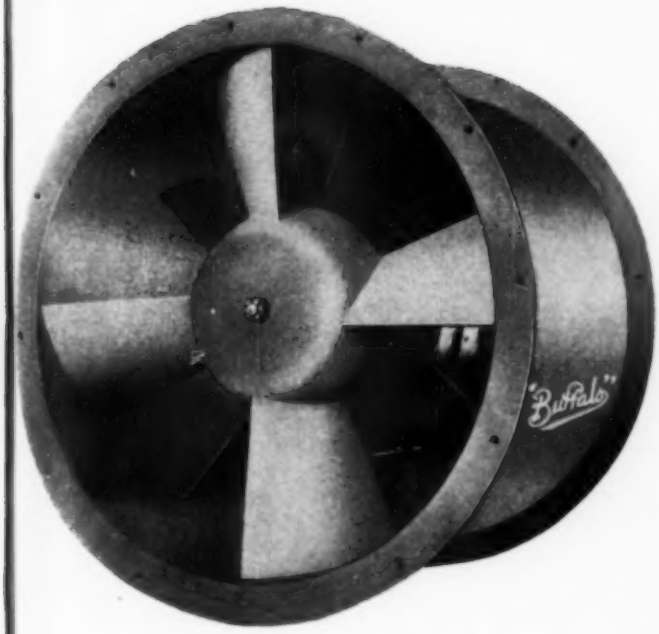
DESIGNATED as Model IT-4 a new Trax cavator for digging, excavating and materials reclaiming has been introduced by Trackson Co., Milwaukee 1, Wis. This device is a crawler-mounted tractor carrying a digging bucket which can be elevated into carrying and dumping position. If desired, the bucket may be replaced with a bulldozer blade. The 1 cu.yd. bucket is able to dig 14 in. below the track line and up to 56 in. above, while it can dump at 7 ft. above the ground.

A SPECIAL non-electric magnet for removing tramp iron and steel from plastic materials has been announced by Eriez Mfg. Co., Erie, Pa. The magnet is designed for installation in aluminum or steel chutes which feed to individual molding machines. In testing out the new magnet the manufacturers discovered that molding equipment not provided with a magnetic separator is subject to many delays, as well as to damage, resulting from tramp iron in the plastic material. In one plant, for example, time lost due to tramp iron amounted to 20 hr. per week, or 1 hour for each of the 20 injection machines. Installation of the magnets completely eliminated such losses.

SPECIAL fittings for coupling lengths of the flexible, non-collapsible tubing manufactured by the Warner Bros. Co., Spiratube

THOUSANDS of these grea

"Buffalo" Fans are in Service



They ARE great fans—not because we say so, but because thousands of users say so. On every kind of ventilating and air conditioning job you'll find Buffalo Limit Load and Axial Flow Fans in service.

During the past five years, more Buffalo Axial Flow Fans were supplied to the U. S. Navy than any other make — during the same period, these and Limit-Load Fans were also supplied by thousands to Industry.

When you have a job that requires reliable, efficient air-moving—there is a Buffalo Fan to give you the best results.

BUFFALO FORGE COMPANY

501 Broadway, **Buffalo, N. Y.**

Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

There's a "RIGHT" "Buffalo" FAN for every jo

CHICAGO COLISEUM

NATIONAL CHEMICAL EXPOSITION

SEPT. 10, 11, 12, 13, 14

☆ 1946 ☆

Division, Bridgeport 1, Conn., are not needed due to the development of a new simple coupling for joining and disconnecting individual sections. The coupling is built into the tubing and consists of a flat spring steel collar which may be compressed to slip inside the end of another section, after which it is released to form a strong, tight joint.

SCHUTTE & KOERTING CO., 12th and Thompson Sts., Philadelphia 22, Pa., announces that fittings, valves and jets made of Everdur manganese-silicon bronze are again available for resistance to such corroding agents as sulphuric acid, alkaline sulphates, hydrochloric acid, zinc chloride and similar chemicals.

A NEW METHOD of electronic welding of the seams to make them airtight, leakproof and permanent, is employed in the Pulmotek protective aprons and sleeves produced from a flexible, plastic material by the Pulmosan Safety Equipment Corp., 176 Johnston St., Brooklyn 1, N. Y. The seams are said to be stronger than the plastic material itself, requiring no cementing and sewing. In addition, all straps, grommets, webbing reinforcements, ties, etc., are made of plastic and electronically welded to the garment. Much longer wearing life is said thus to be obtained.

PRODUCTION of its lubricated plug valves to include cast steel valves of Series 100 and 300, in sizes ¼ to 8 in., has been announced by American Car & Foundry Co., 30 Church St., New York 8, N. Y. The new cast steel valves are said to be particularly adapted for use at high pressure and temperature, and where greater abrasion resistance or corrosion resistance is necessary. Applications fall in the field of oil field production, process plants and refineries.

POSSIBILITY of the use of microwaves for analytical purposes is recalled by the announcement of Sylvania Electric Products Co., 500 Fifth Ave., New York, N. Y., of the availability of a new group of microwave tubes including both receiving and low-power transmitting types for use at frequencies between 1,000 and 5,000 megacycles. Passage of many products directly through the microwave circuit may be used to indicate composition, structural faults, degree of moisture content, impurities and other characteristics. It is considered possible that many applications in control, sorting and measurement will result from this method.

FOR USE where a small industrial thermometer is necessary, Palmer Thermometers, Inc., Cincinnati 12, Ohio, has developed a new 4-in. industrial model with a Plexiglass shield (instead of glass) and a red-reading-mercury column. The case is of extruded brass.

ACCORDING to a recent announcement by Newark Wire Cloth Co., Newark, N. J., the stress of wartime necessities resulted in the development of 400 mesh wire cloth which was woven from 0.001 in. Monel metal wire. It is understood that the finest wire cloth of ordinary square weave was previously woven with 325 mesh.

CHEMICAL ENGINEERING NEWS

MORE SPACE FOR EXHIBITS AT CHICAGO EXPOSITION

TIMED to be held during the period of the meeting of the American Chemical Society, the Fourth National Chemical Exposition will open at the Coliseum Chicago, on September 10 and continue through the remainder of that week. The show is sponsored by the Chicago Section of ACS and Dr. H. E. Robinson, chairman of the committee in charge, has announced that additional space will be made available for exhibits through the use of the second floor of the Coliseum annex which was utilized as a conference hall during the last show in 1944.

So as not to conflict with the sessions of the national society, the National Industrial Chemical Conference which has featured previous shows will be dispensed with. However a special committee, headed by James K. Stewart of the Sherwin-Williams Co., is working with show manager Marcus W. Hinson to develop an exhibit called "Chemical Trail Blazers" which was introduced for the first time in 1944. This is a constructive, educational display in which awards are to be made for the most outstanding contributions in new ideas, new developments and new applications to industrial chemical progress.

ELECTROCHEMISTS TO HOLD MEETING IN TORONTO

PLANS are rapidly taking shape for the fall meeting of The Electrochemical Society, Inc., which will be held at the Hotel Royal York, Toronto, Canada, on October 16-19. Local committees are in charge of arrangements with C. E. Macdonald, International Nickel Co. of Canada, Ltd., chairman of the committee of finance; M. J. McHenry, Hydro-Electro Power Commission of Ontario, chairman of the committee on plant visits, transportation, and afternoon entertainment; John Sumner, Canadian National Carbon Co., Limited, chairman of hotel arrangements, excluding evening functions; A. E. Byrne and W. Arthur Irvine, Canadian General Electric Co. Limited, chairmen of formal dinner and dance to be held on October 17; Arthur C. West, Canadian Hanson & Van Winkle Co., Ltd., chairman of informal evening gathering scheduled for October 18; and Mrs. A. E. R. Westman, heading the ladies committee.

DU PONT ORGANIZES NYLON RESEARCH SECTION

A NYLON Section has been established in the Chemical Division of the Du Pont company's Ammonia Department to centralize all the department's research and development work on chemicals used in making nylon. Nylon intermediates are manufactured by the Ammonia Department and sent to plants of Du Pont Rayon and Plastics Departments for further processing into textile fibers, monofilaments, and molding powder.

Dr. E. C. Kirkpatrick is director of the new Nylon Section and Dr. A. G. Weber, who has been director of the Ammonia Department laboratory, now heads the General Section. Both have headquarters at the Du Pont Experimental Station in Wilmington.

ACS AWARDS FELLOWSHIPS FOR CHEMICAL RESEARCH

NINE fellowships aggregating $45,000 have been awarded by the American Chemical Society to advanced students of chemistry and chemical engineering to enable them to engage in research and teaching after obtaining the doctor's degree, it is announced by Bradley Dewey, president of the Society.

The postdoctoral fellowships, which are in addition to 59 predoctoral fellowships totaling $100,000 recently granted by the Society, carry a stipend of $2,500 a year, with the institution at which the recipient studies providing an additional sum for teaching. Awards are for one year but will be renewable for a second year upon proof of satisfactory performance.

Ten more postdoctoral fellowships will be granted by the Society by next March 1 to chemists and chemical engineers who received the doctor's degree since Jan. 1, 1940, and were engaged in war work, or who will have obtained the doctor's degree during the 12-month period before Nov. 1, 1947.

PERFECT SAFETY RECORDS AT PLASTICS PLANTS

THE Hercules Powder Co., Wilmington, and the B. F. Goodrich Chemical Co., Cleveland, are winners of the 1945 Plastic Materials Manufacturers Association safety contest. Both companies had perfect safety records with no lost-time accidents during the year, but the Hercules Parlin, N. J., plastic plant placed first for having a greater number of man-hours worked than the Niagara Falls plant of the Goodrich company. Engraved plastic plaques have been awarded the winners.

LIME ASSOCIATION SPONSORS FELLOWSHIP AT RUTGERS

THE National Lime Association has established a fellowship at Rutgers University in the department of sewage and waste treatment. This fellowship is a continuation of work that has been carried on for some time by the National Lime Association and is highly important in the broad general program of the treatment of industrial wastes. It is under the direction of Dr. Willem Rudolfs who selected R. P. Logan, a former National Lime Association fellow, to be directly in charge of the project. R. Y. LeVine, Ch. E., a graduate student, is carrying out the laboratory work.

The program is concerned with the utilization of various types of lime products in the treatment of water wastes. An important phase of the work is the study of the utilization of lime in the treatment of pickling liquor such as is obtained from steel producing and fabricating centers. Particular emphasis is being placed on the difficult sludge problem that is associated with this neutralization.

EUROPE WILL SUPPLY BULK OF OWN CHEMICAL NEEDS

DESPITE a tremendous lack of skilled technical workers, Leonard T. Beale, president of Pennsylvania Salt Mfg. Co., said recently, upon his return from Europe, that the chemical industry in Europe soon will be fully reconverted and prepared to supply all the chemical needs of Europe without help from the United States. Mr. Beale, who spent a month in England, France, Germany and Denmark, said the industry's reconversion problem abroad was much greater than that in the United States because the shortage of technicians was much more acute.

"It appeared to me after talks with various chemical manufacturers in England and on the continent that nothing will delay a swift conversion to peacetime chemical production in Europe once skilled manpower becomes available," Mr. Beale said. "There was another worry in England, where there is a fear that the chemical industry may soon join the list of nationalized industries. While I was in England, the government had just nationalized the steel industry," Mr. Beale said. "This step alone brought the nationalization worry directly home to the chemical manufacturers because in that country the chemical and steel industries are so closely allied. Some of the chemical manufacturers I met in England were fearful that such a step might be imminent. Undoubtedly nationalization of the English chemical industry would set its reconversion back many years.

"However, except for that one possibility, the reconversion of the chemical industry abroad should move along swiftly now, and I have no doubt that the manufacturers in France, England and other industrial countries will have no trouble at all in supplying all the European demands for chemicals. They easily will fill up the gap left by the dormant German chemical industry.

"There is no indication that American chemical manufacturers will be called upon to supply any basic chemicals in Europe. They have adequate supplies of almost all basic raw materials. They have the research facilities, and they have the background for full production. They have available almost all the processes we have in this country.

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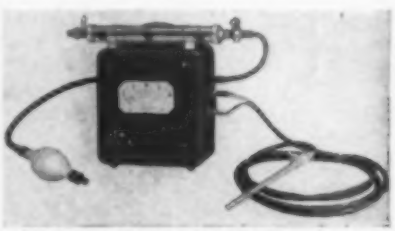

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Write for descriptive Bulletin 700

Charles Engelhard Inc.
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And the ones they do not have they easily can get. Pennsalt is making available various of its processes to chemical firms in allied European countries.

"During our recent visit there we arranged for the acquisition of some French and English chemical processes. We are negotiating on others. Meanwhile, we have already licensed the use of several of the processes we developed in our own research laboratories for the production of chemical products both in France and in England.

"The only immediate obstacle—besides the manpower shortage—appears to be the price controls over the industry, particularly in France, where the French version of the OPA has the chemical industry producing most items on a non-profit basis, and some on a direct loss basis."

In Denmark, Mr. Beale said, there was no need for mass production of chemicals. The Danes long have satisfied their chemical needs by imports from other European countries. They find it unnecessary to establish a large chemical manufacturing industry of their own. "Our visit to Denmark was chiefly for the purpose of renewing contacts with the owners of the Greenland cryolite mines to insure an adequate supply of crude cryolite ore here in America, where it is so vital in various industries."

He pointed out that crude cryolite ore, from which Pennsalt manufactures products for the aluminum, ceramics, insecticide and other industries, was one of the most vital imports during the war. It was so vital to aluminum airplane manufacture that even before Pearl Harbor, the United States Navy was convoying Pennsalt cryolite ships from Greenland to Philadelphia.

PHILADELPHIA QUARTZ MARKS ITS 115TH ANNIVERSARY

THE Philadelphia Quartz Co., Philadelphia, observed the 115th anniversary of its founding on July 21. From the humble soap and candle factory established in 1831 by Joseph Elkinton, the enterprise has developed into a national producer of silicates of soda with plants at Anderson, Ind., Baltimore, Md., Buffalo, N. Y., Chester, Pa., Jeffersonville, Ind., Kansas City, Kans., Rahway, N. J., St. Louis, Mo., and Utica, Ill. In addition three plants located at Berkeley and Los Angeles, Calif., and Tacoma, Wash., are operated by a subsidiary, the Philadelphia Quartz Co. of California, Ltd. A Canadian subsidiary is National Silicates, Ltd., with offices and plant at Toronto.

The present firm name was first used in 1864 when a partnership was formed to produce silicate of soda in a separate plant. Soap manufacture was discontinued in 1904. Thomas W. Elkinton, great-grandson of the founder, is now president of the company.

NEW ORGANIC CHEMICAL PLANT FOR KANKAKEE

LAST month James F. Bell, chairman, and Harry A. Bullis, president of General Mills, Inc., announced completion of plans and preliminary arrangements for construction of a new organic chemical plant to be located at Kankakee, Ill. The new facility will be specially designed for the production of fatty acids and fatty acid derivatives. The new plant will be an important unit of the Chemical Division of General Mills, and will be under the supervision of Arthur P. Berry, manager of fatty acid operations. Location of the plant will be on a 30-acre site lying about one mile south of the city limits of Kankakee.

NEW RESEARCH LABORATORIES PLANNED FOR STAMFORD

PLANS have been completed and a site in Stamford, Conn. has been acquired for the new chemical research laboratory of Air Reduction Co., Inc., and U. S. Industrial Chemicals, Inc. The new laboratory will accommodate the 200 technical employees constituting the chemical research staffs of the two companies.

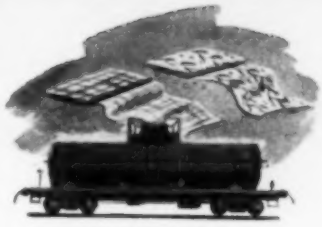
U. S. Industrial Chemicals' research will concern solvents, resins, other chemicals, and chemical manufacturing processes. Air Reduction's staff will be occupied in research relating to new uses for the various chemical products of Air Reduction and subsidiaries, together with research on other chemicals of interest to the company.

At present the chemical research laboratories of Air Reduction and U. S. I. are in Stamford, where Air Reduction's liquefaction research laboratory and rare gases division are also located. When the chemical research staffs move to their new quarters,

The American Section of the Society of Chemical Industry has elected officers who assumed their duties on July 1. The new chairman is S. D. Kirkpatrick, editor of *Chemical & Metallurgical Engineering* (left) and the new vice chairman is Cyril S. Kimball, Foster D. Snell, Inc. (right)

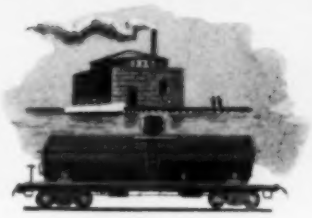
ALCOHOL

Clean, steel car, 6,000 to 10,000 gallon capacity.



CAUSTIC SODA

Heavily insulated steel car, with or without heater coils, 8,000 or 10,000 gallon capacity. Usually specially lined.



CHLORINE

Insulated, welded car; built to withstand pressure up to 500 pounds; 15 or 30 ton capacity.

COTTONSEED OIL

Clean, steel coiled car of 8,000 gallon capacity

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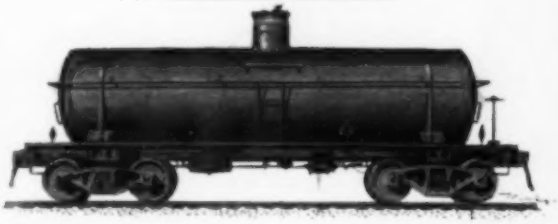

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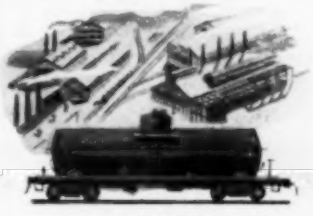
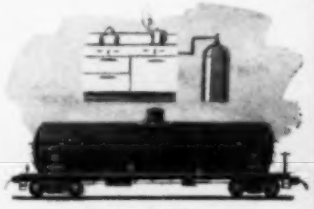


FUEL OIL

Steel car, steam coiled, 8,000 to 12,500 gallon capacity.



PROPANE

Heavily constructed car, welded and insulated. Built to withstand internal pressures to 300 pounds. Capacity 10,000 to 11,000 gallons.

CORN SYRUP UNMIXED

Clean, steam coiled with heavy truck capacity. Usually lined with aluminum paint.

LUBRICATING OIL

Steel car, with steam coils, single or multiple compartment; usually 8,000 gallon capacity.

MURIATIC ACID

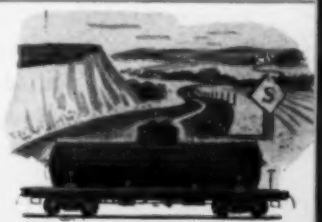
Car lined with pure or synthetic rubber; 8,000 to 10,000 gallon capacity.

ACETIC ACID

Aluminum Car, 8,000 or 10,000 gallon capacity.

GASOLINE

Clean car, 6,000 to 12,500 gallons; single or multiple compartment.



ASPHALT OR TAR

Heavily steam coiled car; with 2 or more inches of insulation; steam jacketed outlet; 8,000 to 10,000 gallon capacity.

LARD

Clean steam coiled car, usually of 8,000 gallon capacity.

WINE

Insulated car with one to six compartments. Interior coated to preserve quality.

MOLASSES

Steam coiled car with heavy capacity trucks; 8,000 gallon capacity.

SULPHURIC ACID

Heavily constructed steel car with heavy truck capacity. Equipped to unload through dome.

New Coal Tar Chemicals by Reilly

2-Mercaptoethylpyridine

PHYSICAL CONSTANTS OF THE PURE COMPOUND

Molecular Weight	139.14
Freezing Point	−25.0°C.
Boiling Point at 13 mm.	106°C.
Boiling Point at 39 mm.	134°C.
Density at 25°C.	1.084
Refractive Index n20D	1.5605
Solubility in 100 g. water at 20°C.	0.3 g.
Solubility of water in 100 g. at 20°C.	10.7 g.

● 2-Mercaptoethylpyridine is a most unusual organic compound, possessing a sulfhydryl group in addition to the pyridine ring. The presence of the sulfhydryl group makes 2-Mercaptoethylpyridine a most reactive and versatile pyridine compound.

2-Mercaptoethylpyridine is available in 95% minimum purity, with a minimum freezing point of −27.4°C. A few of the suggested uses are: as a polymerization modifier in synthetic rubber; as a vulcanization accelerator; as a plasticizer; as an insecticide and fungicide; as a raw material in the synthesis of dyestuffs and pharmaceuticals; as an intermediate in the preparation of sulfides, thioesters and metal salts; as a starting material for the synthesis of pickling inhibitors, flotation reagents, emulsifying and wetting agents and as a solvent.

Further information on 2-Mercaptoethylpyridine and other new Reilly Coal Tar Chemicals will be furnished on request.

This 56-page second edition and supplement describing the complete Reilly line of coal tar chemicals, acids, oils, bases and intermediates will be sent on request.

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Reilly Coal Tar Chemicals for Industry

the buildings formerly occupied will continue to house the rare gases division, and will provide the space needed for carrying on liquefaction research on an expanded scale.

JUNIOR CHEMICAL ENGINEERS HOLD ANNUAL MEETING

COMPLETING its ninth year of existence, The Junion Chemical Engineers of New York held its annual business meeting in New York on the evening of June 13. Reports were submitted by the various committees and the following officers were elected for the coming fiscal year: Andrew A. Melnychuk, Plastics Division, Celanese Corp., Newark, N. J., president; Edgar L. Demarest, Heyden Chemical Co., Garfield, N. J., vice president; Edmond C. Fetter, *Chemical & Metallurgical Engineering*, New York, secretary-treasurer; and J. G. Bronson, Westvaco Chlorine Products Corp., New York, assistant secretary-treasurer.

ALL DIVISIONS TO CONVENE AT ACS CHICAGO MEETING

DR. FRED C. KOCH, director of biochemical research at the Armour Laboratories has been appointed general chairman of the 110th national meeting of the American Chemical Society, which will be held in Chicago September 9–13, A. E. Schneider of the Armour Laboratories has been named general assistant to Dr. Koch.

More than 8,000 chemists, chemical engineers and representatives of allied fields will participate in the sessions, at which ad-

CONVENTION CALENDAR

American Institute of Chemical Engineers, regional meeting, Palace Hotel, San Francisco, Calif., August 25-28.

American Chemical Society, 110th meeting, Chicago, Ill., September 9-13.

Fourth National Chemical Exposition, Coliseum, Chicago, Ill., September 10-14.

Instrument Society of America, First National Conference and Exhibit, William Penn Hotel, Pittsburgh, Pa., September 16-20.

The Electrochemical Society, Inc., fall meeting, Hotel Royal York, Toronto, Canada, October 16-19.

Engineering Society of Western Pennsylvania, Seventh Annual Water Conference, Hotel William Penn., Pittsburgh, Pa., October 28-30.

Federation of Paint and Varnish Production Clubs, annual convention and paint industries show, Hotel Claridge, Atlantic City, N. J., November 4-6.

National Paint, Varnish & Lacquer Association, annual convention, Atlantic City, N. J., November 6-8.

Seventeenth National Exposition of Power and Mechanical Engineering, Grand Central Palace, New York, N. Y., December 2-7.

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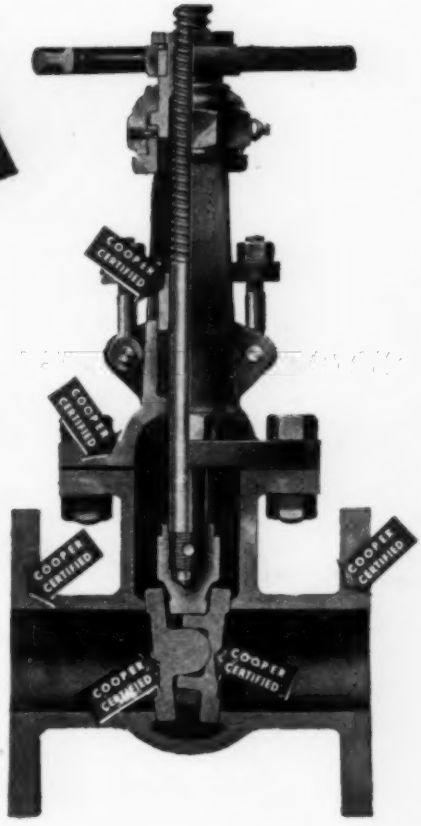

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Standard types of "Certified" Stainless Steel valves offered now include: Globe, Gate, Y, Check, Needle, Quick-opening. COOPER valve users may obtain certificates on request with each unit specified.

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THE COOPER ALLOY FOUNDRY CO.

STAINLESS STEEL VALVES

IMPORTANT

FOR THE MAN IN CHARGE OF *PRESSURE GAGES*

This is the first technical catalog written on pressure gages. It explains the theory of operation and gives all the technical details of modern gage construction. It tells how the Helicoid movement works—an exclusive feature of Helicoid Pressure Gages. If you use any quantity of pressure gages in your operations, the man in charge of your gages should have a copy of the new Helicoid Gage catalog.

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TRADE MARK

vances in virtually every major branch of chemical science and industry will be reported, according to Bradley Dewey, president of the Society. All of the Society's 18 professional Divisions will convene and several hundred papers will be presented at the meeting, the sixth to be held in Chicago since the Society was organized in 1876.

Five vice-chairman have been named to aid Dr. Koch in organizing the convention. They are: Dr. Walter M. Urbain of Swift & Co., Dr. Ervin W. Hopkins of the Armour Laboratories; Prof. Frank T. Gucker, Jr., of Northwestern University; Dr. Everett J. Hoffman of the Armour Laboratories, and Prof. Thomas F. Young of the University of Chicago.

WITTENBERG HEADS MARKET RESEARCH ASSOCIATION

At its annual meeting held at the Biltmore Hotel, New York, last month, the Chemical Market Research Association elected Robert B. Wittenberg president for the coming year. Mr. Wittenberg was one of the founders of the informal group of research men which was incorporated as

Robert B. Wittenberg

the Chemical Market Research Association. Other officers elected with Mr. Wittenberg are Dr. W. H. Bowman, Jefferson Chemical Co., vice president; J. M. Gillette, Victor Chemical Works, recording secretary; A. J. Fisher, U. S. Industrial Chemicals, Inc., corresponding secretary; S. P. Gibson, Jr., Commercial Solvents Corp., treasurer. Councillors selected were the retiring president, James G. Park, Standard Alcohol Co.; James H. Boyd, Phillips Petroleum Co.; and W. N. Dennis, American Cyanamid Co.

HIGHER PRICES ESTABLISHED FOR NATURAL RUBBER

The American, British, French and Netherlands governments have agreed to continue the international allocation of natural rubber during the period of July 1 through December 31, 1946. However, the arrangement which terminated in June whereby the United Kingdom bought all rubber for export from Malaya and resold it to the United States or other governments has ceased with respect to shipments elsewhere than to the United Kingdom. Under the new agreements the United States may purchase rubber from Malaya

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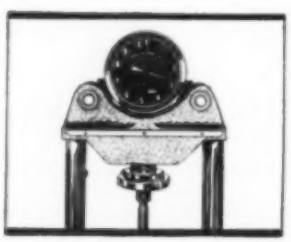
Standing only 37" high, weighing but 137 lbs., the Dillon Universal Tester checks wire, copper, aluminum, fabrics, steel, etc. for tensile, transverse, compression and shear strengths. Available in 7 capacities, with interchangeable dynamometers, the Universal will test from 0 to 10,000 lbs. Special gripping jaws are made for every requirement.



Interchangeable Dynamometer

The Universal Tester may be either hand or motor operated. No special training is needed to record accurate results instantly on the dynamometer. It is compact, simple, inexpensive—designed for small shops and plants everywhere.

Tests prove that workers, too, undergo strain and nervous tension on the job. That's why many factories urge workers to chew gum. Workers can chew Wrigley's Spearmint Gum right on the job—even when hands are busy. And the act of chewing helps relieve monotony—helps keep workers alert, thus aiding them to do a better job with greater ease and safety.

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W. C. Dillon & Co., Inc.
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AA-80

Charles S. Munson
Mr. Munson, who recently was elected president of the Manufacturing Chemists' Association, is president of Air Reduction Co. and chairman of the executive committee of U. S. Industrial Chemicals, Inc.

in any manner desired. American arrangements to procure rubber from Netherlands and French Far Eastern territories were still being discussed a few weeks ago.

The Combined Rubber Committee of the international group will continue to handle the details of allocation. This country has applied to the committee for allocations during the new period of 145,000 long tons from British, French and Netherlands sources. Rubber allocated to this country will be bought by the Rubber Development Corp. at a basic price of 23½ c. per lb. f.o.b. Far Eastern ocean ports, for No. IX ribbed smoked sheet, with differentials for other grades, which represents an advance over the prices of June 30

RESTORATION OF OVERSEAS ENGINEERING LIBRARIES

An appeal recently issued to engineers throughout the country to contribute books and other technical literature to help restore engineering libraries overseas has been renewed with the announcement that the five national engineering societies responsible for the campaign have joined forces with the American Book Center for War Devastated Libraries, Inc., with headquarters in the Library of Congress, Washington, D. C. The Book Center will be a shipping point for volumes given through the engineers, and will receive, sort, assign, pack and ship the books.

Contributors are asked to state their book offering in writing directly to Chairman of Book Commission, Engineers Joint Council, 29 West 39th St., New York 18, N. Y. Gifts of money will be used by the committee to obtain books for special needs.

GEORGIA HAS RAW MATERIALS FOR GLASS PRODUCTION

Further development of glass factories in Georgia to use feldspar within the state rather than for out-of-state shipment, has been proposed by Garland Peyton, director of the State Department of Mines, Mining and Geology. Mr. Peyton said that one plant near Monticello is producing crude feldspar and further possibilities are being

MODERN DEVELOPMENTS OF GASKET RESEARCH

V-TITE...

A BETTER JOINT SEAL FOR HIGH PRESSURE LINES

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developed. He declared that his department has made several investigations of a glass sand deposit near Lumber City, Wheeler County, from which glass sand formerly was shipped to Chattanooga, Tenn., and to Tallapoosa where it was used in the manufacture of bottles.

CORRECTION

In the May issue of *Chem. & Met.*, a line was dropped in reporting the address given by Fred A. Soderberg, head of Paper Department, Service & Development Division, General Dyestuffs Corp. at the market research symposium for the Junior Chemical Engineers of New York. What Mr. Soderberg said was "Years of experience have taught us that it is advisable to offer the small as well as the large concerns all the help we possibly can. If you do an outstanding job of technical service, the good will of the customer may be yours for a long period of time." As printed, reference to the small concerns was omitted which gave an incorrect view of the company's policy.

READERS' VIEWS AND COMMENTS

STRESS AND RUPTURE

To the Editor of Chem. & Met.

Sir:—In *Chemical & Metallurgical Engineering* for March 1946 there is an article entitled "Simplified Methods for Calculating Stresses in Pressure Vessels," by Carsten F. Boe.

The title creates an erroneous impression, and the article itself is confused. The opening statement is: "There are a considerable number of theories, or formulas, relating to the calculation of safe wall stresses (Table I) and they give different results." The fact is there is only one theory, and it does not purport to give safe stresses—it gives actual stresses in a structure of given dimensions under a specified loading. Whether or not the actual stresses are safe is a question which cannot be answered by a handbook.

The world is swarming with men who can calculate the stresses in almost any structure subjected to given loading. There is an occasional engineer who knows how to use the results in a safe and rational design. Mechanics of Materials is an important subject in the training of an engineer but no one believes that engineering consists in selecting a more or less "conservative"(?) formula from a list, each purporting to give stresses, but no two giving the same result.

One of the items which must be considered in structural design is magnitude and distribution of stresses, but it is only one of many. Stress distribution and its concomitant strains can be calculated by use of the mathematical theory of elasticity, which has been characterized by M. Paul Langevin as "one of the most perfect theories of physics." However, there is but one correct answer to a given problem; if you don't like it, you are not privileged to select an-

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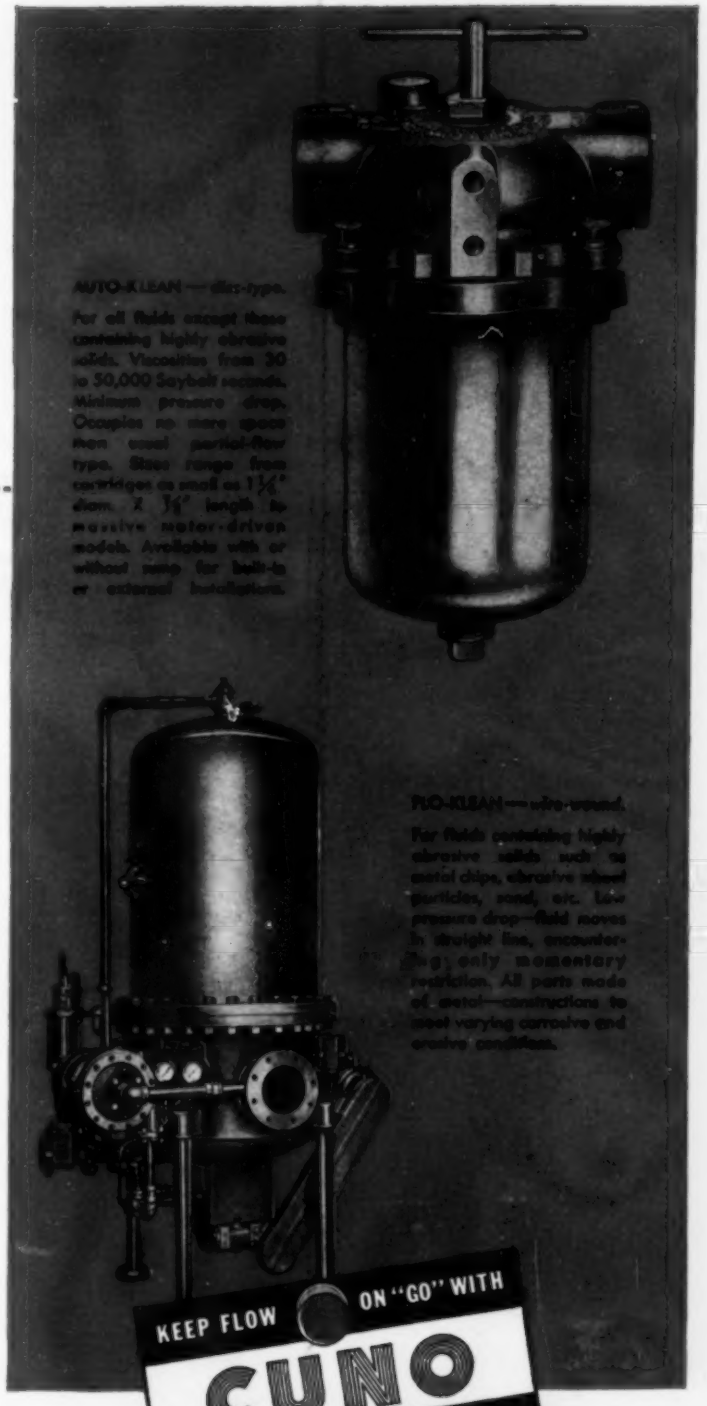

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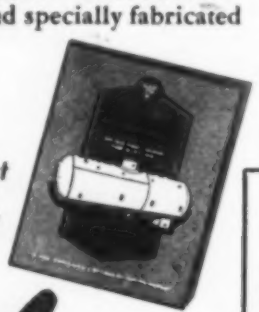

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other formula which will give a result more in accord with your preconceived notion.

An important cause of the confusion of ideas and the resulting misinterpretation and misuse of formulas is that people often ignore the limitation on all stress calculations, i.e., that they are valid only within the elastic limit. Hence, comparisons are constantly being made between calculated stresses and breaking loads. Thus, Mr. Boe's Table 1, which is entitled "Theories relating to calculation of wall stresses in pressure vessels," is misnamed, being actually a statement of the various criteria of rupture which have been proposed from time to time.

Over the years there has accumulated an enormous quantity of information on the direct tensile strength of steel and other bars, and on the accompanying elongations and the contractions of cross sectional area. Since the elongation and the tensile stress increase *pari passu* it is not obvious whether the eventual failure is due to the one or the other. A piece is designed to resist a given force and it is natural that the allowed stress should be some fraction of the breaking strength or of the elastic limit. Sometimes it is more important to limit distortion and the piece must be proportioned accordingly.

Something more than a hundred years ago Poncelet and Barré de St. Venant revived a principle first enunciated by Mariotte in 1682, "that extended pieces break only because their extension surpasses a certain proportion." There is ample experimental support for this theory of rupture, and it has been widely applied under the name "maximum strain theory." It is, however, not correct that the application of this principle gives different stresses than are found in other theories of rupture. The actual stresses can be readily calculated; their effect on the material is another question.

That the so-called Clavarino formula does not give actual stresses is obvious from the following considerations:

In a cylinder with internal and external radii r_1 and r_2, respectively, internal pressure P, and external pressure 0, let $q = r_2/r_1$ and m = reciprocal of Poisson's ratio. Then the so-called radial stress is

$$\sigma_r = \frac{P}{m(q^2-1)}\left[(m-2) - (m+1)\frac{r_2^2}{r^2}\right]$$

at radius r. If this were an actual stress it should become P for $r = r_1$ and 0 for $r = r_2$. It does neither. By changing the sign between the two terms in the bracket from minus to plus, and making $m = 10/3$, we obtain the Clavarino formula for so-called circumferential stress, but it is not stress.

A volume might be written on the various theories of rupture but the point to be emphasized here is that the calculation of stress is in no way a dependent on them. Stress calculations are valid only below the elastic limit, rupture or plastic deformation occurs only above that limit.

Under the heading "Conclusions Drawn" Mr. Boe makes the statement: "For instance, for very heavy-walled spheres with internal pressure, Max. Princ. Stress gives three times the value of Max. Shear Stress or Max. Deform. Work. This means that a solid ball of metal with a tiny spherical hole in the center would take a pressure of twice the tensile strength of the material, which is definitely absurd."

No such conclusion can properly be drawn. Provided the stresses do not exceed the elastic limit, it is true that the maximum

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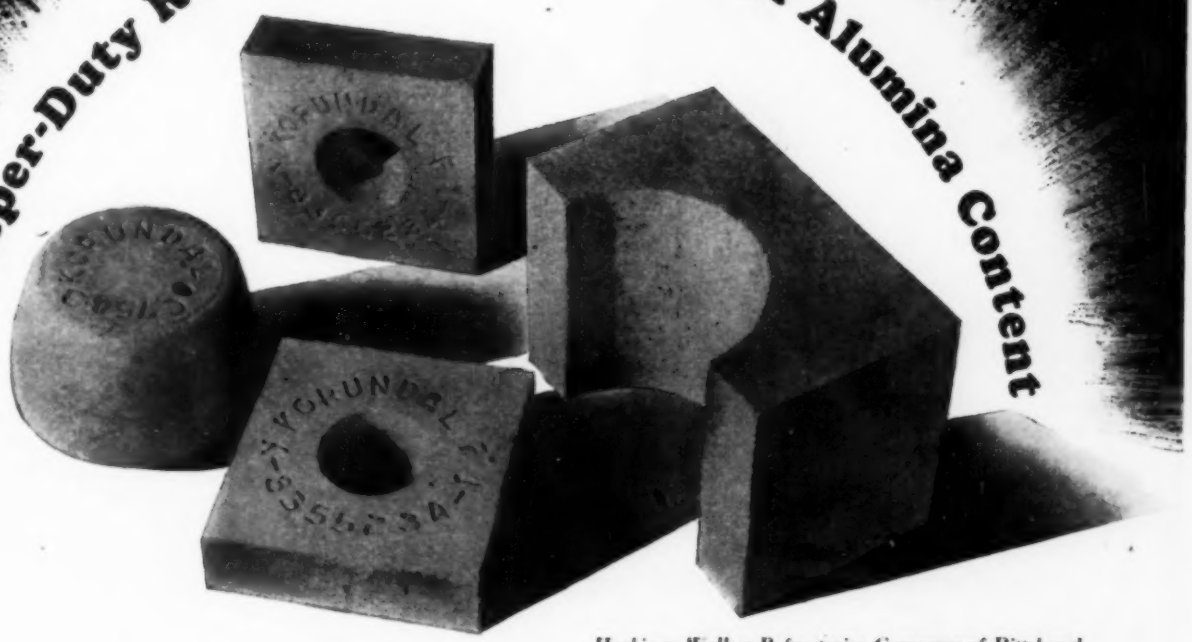

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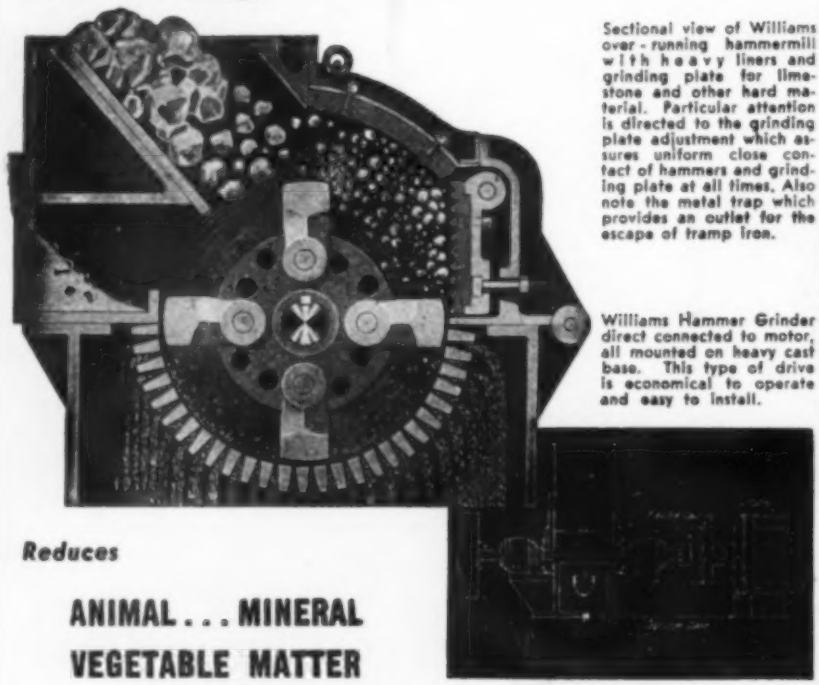

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principal stress approaches one-half the internal fluid pressure as the hollow sphere approximates a solid ball. There is nothing absurd about that; the absurdity is in the attempt to relate the fluid pressure to the tensile strength of the envelope.

The first sentence in the above quotation is, to put it mildly, hazy. "Max. Princ. Stress gives three times the values of Max. Shear Stress or Max. Deform. Work." Values of what? Does this mean that some one formula gives stresses three times as large as does some other formula? If so, both are probably wrong. To consider two such formulas as alternative methods for calculating the same thing, and to pick the answer to suit one's purpose, indicates a need to return to fundamentals.

Design of a pressure vessel involves a good many considerations. Stress calculation is one, and there is but one method and one correct answer. Then the temperature of operation has to be taken into account, along with the properties of the construction material at operating temperature. How much alteration in dimensions can be tolerated? What possible chemical interaction may there be between its material and its contents? These are only some of the design problems. You cannot enter a table or a diagram with a figure for pressure, and come out with a design for a reaction vessel.

CHARLES W. COMSTOCK

Jackson Heights, N. Y.

SECOND SCHOOL OF THOUGHT

To the Editor of Chem. & Met:

Sir:—The interest shown by Mr. Comstock in my article is highly appreciated. Many of his comments are well taken, although they are beyond the scope of my article, which, due to space limitations was limited to present a comparison between various formulas in practical use as listed in handbooks and referred to in the literature.

It was not the intent of the author to influence the designer in his selection of any formula. It was assumed that the reader who would use the formulas, would be familiar with the theory of elasticity and the various theories of rupture and their limitations.

Books have been written on the theory of elasticity, excellent ones as for instance Timoshenko's "Theory of Elasticity." Therefore there is nothing new about calculating actual stresses within the elastic limit of the material. However, to put this theoretical material to practical use is another thing. That is what the various theories of rupture attempt to accomplish.

There are two schools of thought, so to speak; both very useful at the present time. The one that Mr. Comstock apparently belongs to calculates the actual stresses and determines whether these are safe. The article was limited on account of the above reasons, to the other school of thought: calculate the rupture pressure and determine whether the operating pressure is safe.

It is well known that there is only one correct answer to the strength of a pressure vessel, and that is rupture tests. My article was primarily concerned with theories of ruptures. The practical value of these theories and formulas is obvious:

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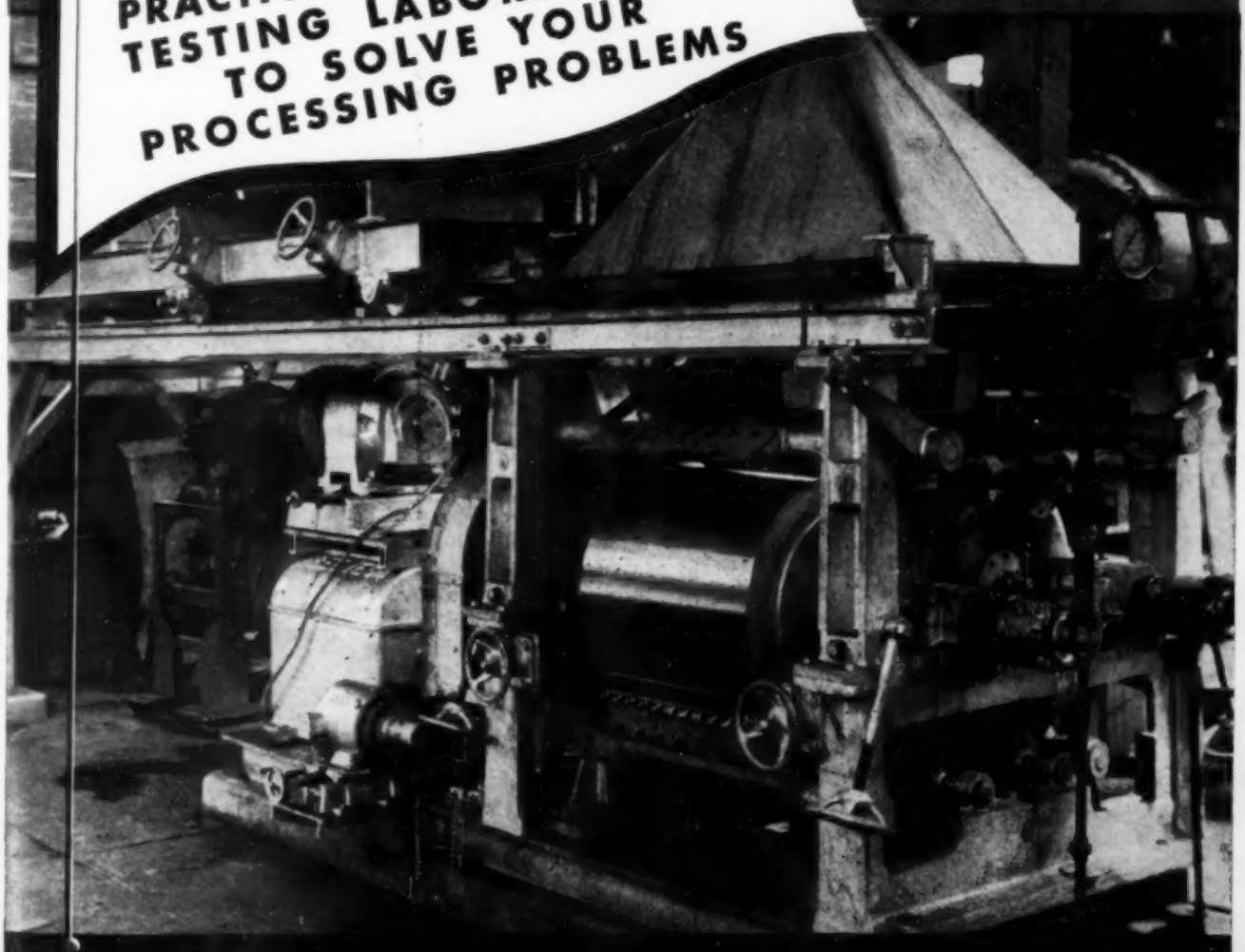

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In practical application of the theory of elasticity as well as the various theories of rupture the designer is interested in knowing the magnitude of the safety factor involved. Regardless of how this safety factor is defined, it must of necessity be a function of the failure of the vessel. Such failure cannot take place unless the validity of Hooke's Law and other basic principles of the theory of elasticity is impaired, unless a new and revolutionary material of construction is invented or discovered.

Full knowledge of the existing and real stresses at the operating pressure is important in estimating the safety factor. Likewise, test data of the physical properties such as tensile, compressive and shear strength, yield point, creep data, etc., are equally important in design. The trouble starts when the thorist tries to correlate test data with the theories and many perplexing and contradictory conditions are encountered. Some materials behave differently from others.

The various theories of rupture referred to in my article represent various attempts made from time to time to correlate theory with test data, and because they assume different reasons of failure, they must necessarily give different results (rupture pressures). Which of these theories involve the smallest error in use would depend on the physical properties of the material. The error involved is largely due to the attempt made in utilizing one-dimensional, simple test data such as tensile strength as basis for a failure of a three-dimensional stress-condition. How this is done was beyond the scope of my article, but is illustrated by means of an example.

The maximum strain formula gives a hypothetical stress in the tangential direction of such a magnitude that its effect on the material below the elastic limit is equal to the maximum strain produced by the combined effect of the real three main stresses—the tangential, the radial and the longitudinal stress (for cylinder). To obtain the formula it is necessary to use the theory of elasticity and the principle formulated by de Saint Venant that the total strain from several stresses can be obtained by addition of each strain produced by each separate stress.

Mr. Comstock cites an example of such a hypothetical stress in the radial direction. This formula gives values which are always smaller than the corresponding stress in the tangential direction and was therefore not listed in Table II in my article. However, this formula is important in design of heavy walled cylinders for internal pressure if the compressive strength of the material is very small compared to its tensile strength. Using the terminology in my article, the maximum value of this "stress" at the inside of the cylinder would be expressed by:

$$C = 0.75 + Y \text{ for } m = 0.25$$
$$C = 0.9 + Y \text{ for } m = 0.3$$

in the formula $P/S = Y/C$.

In my article, it was pointed out that the maximum principal stress and the maximum strain formulas seemed to give unsafe results

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for heavy-walled spheres under internal pressure. One of the reasons for this is that these formulas do not consider the radial stresses, and that the latter may be causing the failure. It can be shown that the quality of the formulas referred to as Maximum Principal Stress and Maximum Strain is highly dependent on the relation of the compressive strength of the material to its tensile strength. If curves and formulas for the maximum radial stress and the maximum radial "strain-stress" had been included, this would have been obvious. Furthermore, they would have indicated that "the ball with a tiny hole in the center" would generally fail before the pressure (in pounds per square inch) would reach a height of twice the tensile strength of the material (in pounds per square inch), provided that the compressive strength of the material is less than twice the tensile strength. As this is generally the case, it only goes to show that great caution should be exercised when using these formulas in design.

The relatively newer theory of rupture called "The Maximum Strain Energy" with its modification (Maximum Deformation Work) gives formulas that due to their derivations and the assumptions made do not involve the above complications. The curves shown in the article also indicate a more conservative result which may be preferred from safety point of view.

It is well known that further improvements of the existing theories of rupture, would be of great value in design of pressure vessels.

C. F. Bor

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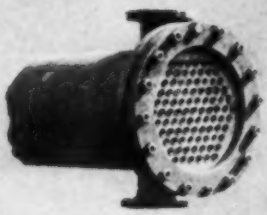

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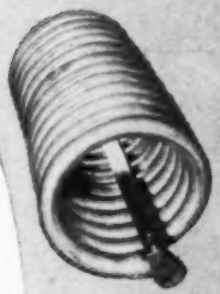

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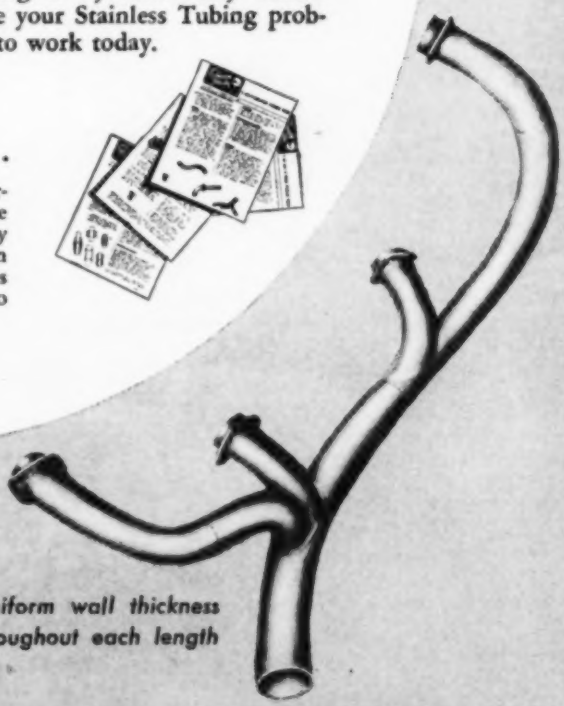

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STAINLESS TUBING

This plant of Permanente Cement Co., world's largest of its kind, can turn out 5,000,000 bbl. of cement annually for western construction. The Cottrell system is at the left, while part of the magnesium plant can be seen in the background. The company supplied all bulk cement for the Pacific war theater

PACIFIC PROCESS INDUSTRIES

TRENDS • EVENTS • DEVELOPMENTS

JOHN R. CALLAHAM, Pacific Coast Editor, San Francisco, Calif.

PERMANENTE CEMENT OPERATES AT HIGHEST RATE

REFLECTING the sharply increased construction activity on the West Coast, the Permanente Cement Co. has recently enjoyed its biggest month in history. With an annual capacity of 5,000,000 bbl., the Permanente mill is the world's largest cement plant. It supplied all bulk cement requirements for the Pacific war theater, the major production for the Panama Canal Zone and the 6,800,000 bbl. required in the construction of Shasta Dam on the Sacramento River. The Kaiser-owned company is now expanding its distribution facilities and is adding a new division in Seattle, Wash. Facilities at the port of Redwood City, Calif., include pneumatic pumps which can load a ship with 40,000 bbl. in 18 hr.

Permanente employs unique cement production methods with specially designed equipment. A closed circuit method of raw grinding assures accurate control of fineness and increased production. The slurry has a fineness of 95 percent through 200 mesh, and it is impossible for oversize to pass. Efficient burning of cement clinker is accomplished in four huge rotary kilns, each 463 ft. long and 12 ft. in diameter. Finish mills are also closed-circuited.

RUBBER PRODUCTS FIRM BUILDS IN UTAH

ANNOUNCEMENT was made recently that the Thermoid Co., which has factories in Los Angeles and Trenton, N. J., will construct in the near future an industrial rubber manufacturing plant at Nephi, Utah, 85 miles south of Salt Lake City. J. W. Beard, Los Angeles representative of the firm, stated that more than 300 workers will probably be employed at the plant, which will be situated on a 24-acre site just north of Nephi. Raw materials for the factory will be rubber or synthetic rubber materials and asbestos, which will be used for the manufacture of brake linings, V-belts, refinery hose, sheet packings and other industrial rubber products.

NORTHWEST PULP OUTPUT KEEPS NATIONAL RANK

PRODUCTION of wood pulp by the Pacific Coast states during 1945 maintained the region's percentage of national total essentially the same as for 1944, according to data recently released by the Civilian Production Administration and the U. S. Dept. of Commerce. For both years, the Pacific Coast output of all grades of pulp amounted to approximately 16 percent of the national total for all grades. Washington and Oregon produced for both 1945 and 1944 about 35 percent of the nation's bleached sulphite production, 40 percent of the unbleached sulphite, 10 percent of the unbleached sulphate and 15 percent of groundwood pulp (see accompanying table).

Pacific Coast Production of Wood Pulp by Grades*

	Short Tons	
	1945	1944
Bleached sulphite		
Washington and Oregon	549,652	559,423
Unbleached sulphite		
Washington	207,128	216,409
Oregon	126,161	134,635
Unbleached sulphate		
Washington and Oregon	362,166	367,481
Groundwood		
Washington and Oregon	263,539	260,532
Total all grades †		
Washington	1,265,426	1,256,374
Oregon and California	372,939	412,342

* Census of Pulp Mills and of Paper and Paperboard Mills, 1945, issued by Forest Products Div. of Civilian Production Adm. and the U. S. Dept. of Commerce. † Includes bleached and semibleached sulphate, soda, semichemical and miscellaneous which are not separately shown.

HIGH-OCTANE REFINERY BOUGHT BY UTAH OIL

SALE of the 100-octane aviation gasoline refinery at Salt Lake City to Utah Oil Refining Co. has been announced by War Assets Administration, thus becoming the first of its type to be purchased from the government. The plant, which cost $15,400,000 was sold to the subsidiary of Standard Oil of Indiana for $4,148,300. The refinery, put into operation during April 1944, was leased and operated by Utah Oil Refining Co. to produce aviation gasoline until September 1945, when the firm converted to motor gasoline. The unit is located on a 27-acre tract adjacent to the company's prewar installations. Approximately 450 persons are currently employed at the plant.

The plant was purchased for continued use of the fluid catalytic cracking and vapor recovery units which have a rated capacity of 8,500 bbl. daily, of the sulphuric acid alkylation unit rated at 3,000 bbl. daily of aviation alkylate, and of attendant auxiliaries and tankage facilities. The company has purchased as salvageable equipment those parts of the plant not necessary for civilian production, including a butane isomerization unit with a capacity of 1,000 bbl. daily and an HCl generation unit. The plant has H_2SO_4 recovery facilities.

The Utah company has a refinery at Salt Lake City with a daily capacity of 15,000 bbl. of crude oil which is refined into gasoline, light oils, lubricating oils and greases. The firm owns a 442-mi. 8-in. pipeline operating between Fort Laramie, Wyo., and Salt Lake City. E. S. Holt is executive vice president of Utah Oil Refining Co.

AIChE ANNOUNCES PROGRAM FOR WESTERN CONVENTION

PLANS for the western convention of the American Institute of Chemical Engineers have now taken shape. The meeting will be held in San Francisco, with the Palace Hotel as headquarters, during August 25-28.

The program, which will stress western industry, will include a symposium on chemicals from petroleum raw materials and another on chemical engineering education in the West. A total of 16 technical papers will be given on the regular program. These will include papers on high-temperature pyrolysis control methods and product separations, by United Gas Improvement Co.; ethane-propane cracking, by Stone & Webster Engineering Corp.; production of synthetic alcohol, by Standard Oil of N. J.; manufacture of allyl alcohol, by Shell Development Co.; production of cumene by vapor- and liquid-phase alkylation processes by Shell Development Co.; absorption and purification of HCl from chlorination of hydrocarbons, by Dow Chemical Co.; dimensionless groups and their use in unit operations, by de Bataafsche Petroleum Co.; catalytic desulphurization of high-sulphur stocks by the cobalt-molybdate process, by Union Oil Co. of Calif.; laboratory corrosion testing, by Shell Development Co.; case histories of some corrosion problems in chemical process equipment, by International Nickel Co.; the unit operation of extractive distillation, by Shell Development Co.; design and operation of a light hydrocarbon distillation dryer, by California Research Corp.; power absorption in mixers, by Shell Development Co.; approximate diffusion calculations for falling-rate phase of drying, by the Western Regional Research Laboratory of the U. S. Dept. of Agriculture; preliminary studies of temperature gradients in turbulent gas streams, by California Institute of Technology; performance of non-isothermal jets, by University of California (Los Angeles).

Another symposium will feature 14 "thumbnail" sketches of chemical processes

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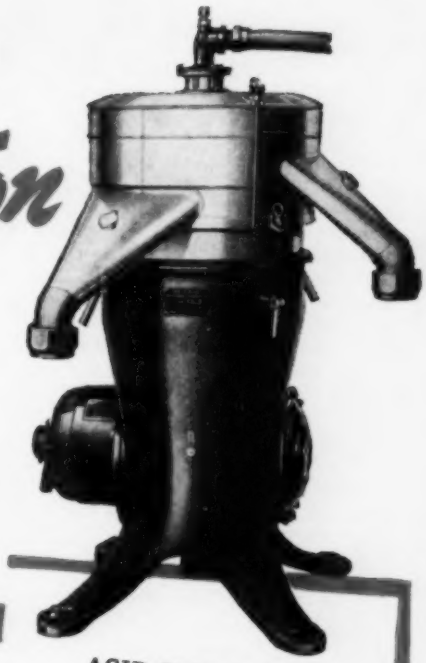
AND A BETTER PRODUCT, Too!



FASTER, more complete separation by continuously applied centrifugal force is the order of the day where plants wish to simplify their processes. De Laval Separators and Purifiers are available in such a great number of types and sizes that they can meet an unusually great variety of applications for centrifugal force. The list at the right is by no means complete, but it may suggest opportunities for ***your*** plant.

In addition to speeding up operations by converting a process to a continuous basis, De Laval centrifugals have two additional advantages worth noting: (1) They effect material savings and (2) Generally, if not invariably, they improve the product.

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For SEPARATION • CLARIFICATION • CONCENTRATION

first commercialized in the West since 1940. Dr. W. Hirschkind of Dow Chemical Co. will preface the symposium by giving a talk on the history and growth of western chemical industry. Among processes to be described briefly will be those for the production of phthalic anhydride from orthoxylene by Oronite Chemical Co.; potassium perchlorate by Western Electrochemical Co.; dimethyl sulfolane by Shell Chemical Corp.; formaldehyde by Casein Co. of America; magnesia-magnesium operations by Permanente Metals Corp.; penicillin by Cutter Laboratories, Inc.; styrene by Dow Chemical Co.; tartrates and other products from winery pomace by E. K. Metzner; a new phosphate-olivine type fertilizer by Manganese Products, Inc.; paraffin wax by Union Oil Co. of California; lithium concentrates by American Potash & Chemical Corp; low-temperature carbonization of coal by Coal Logs, Inc.; alcohol from sulphite liquor by Puget Sound Pulp & Timber Co.

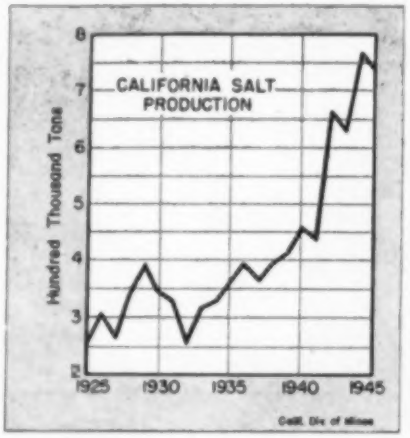
Plant visits in the Bay area will include those to Shell Chemical Corp., Standard Oil of California and Oronite Chemical Co., Great Western Div. of Dow Chemical Co., Western Regional Research Laboratory of the U. S. Dept. of Agriculture, the cyclotron and low-temperature laboratories of the University of California, and California & Hawaiian Sugar Refining Corp.

General chairman of the meeting is C. R. Nelson of Shell Development Co., 100 Bush St., San Francisco. A. George Stern of Westvaco Chlorine Products Corp., Newark, Calif., has charge of registration and hospitality, while George C. Gester, Jr., of California Research Corp., Richmond, will handle arrangements for plant visits. Jose Samaniego is chairman of the arrangements committee while A. V. Caselli is chairman of the entertainment committee; both these men are located at Shell Development Co. in San Francisco. John R. Callaham of *Chemical & Metallurgical Engineering*, 68 Post St., San Francisco, is handling publicity and the "New Western Chemical Industries" symposium. Mott Souders, Jr., of Shell Development Co., San Francisco, has charge of the education symposium.

Placing rubber-lined tank in a vulcanizer at the plant of Western Pipe & Steel Co. Adhesion bonds exceeding 500 psi. can be obtained by the company's process

CALIFORNIA SALT OUTPUT CONTINUES HIGH

SALT production in California for 1945 totaled 734,736 net tons valued at $2,030,226 or a slight decline from the record output during 1944 of 769,873 tons worth $2,060,960 (see accompanying chart), according to data recently released by the California Division of Mines, San Francisco. The average value reported by salt producers in California in 1945 was $2.76 per net ton, f.o.b. plant, compared with $2.68 in 1944 and 1943.



Most of the salt production in California is obtained by evaporation of ocean water at plants located on the shores of San Francisco, Monterey and San Diego bays and at Long Beach. Additional amounts (in part, rock salt) are derived from lakes and lake beds in the desert regions and by evaporation of alkaline lake water in Modoc County. A small amount of valuable medicinal salts has been obtained by evaporation of water from Lake Mono and from a mineral spring in Butte County. Companies reporting salt shipments in 1945 are shown in the accompanying table.

Salt Producers in California, 1945*

Producer	Plant Location
American Salt Co.	Mt. Eden
California Rock-Salt Co.	Amboy
C. C. Miller	Mono Lake
Desert Chemical Co.	Amboy
Leslie Salt Co.	Newark; Mt. Eden
Long Beach Salt Co.	Saltdale; Long Beach
Monterey Bay Salt Works	Moss Landing
Oliver Bros. Salt Co.	Mt. Eden
The Irvine Co.	Tustin
Western Salt Co.	San Diego

* California Division of Mines, San Francisco.

RUBBER-LINED EQUIPMENT OUTPUT EXPANDED

IN REVEALING moves for increasing output of rubber-lined metal tanks and equipment for industry, Western Pipe & Steel Co. of Los Angeles stated that demand for such equipment by the chemical process and related industries of the coast since the end of the war has surpassed the total demand for the entire previous decade. Part of this rise in demand has resulted from the recent growth of the western chemical process fields, while part has resulted from greater acceptance of rubber-lined equipment by engineers due to progress made in coating materials and in methods of bonding. Western Pipe & Steel Co., already the largest steel fabricators in the West, have now become the largest West Coast manufacturer of rubber-lined steel tanks, according to the announcement. In the process used by this firm, the adhesion bond can be made to exceed 500 lb. per sq. in. Recent developments now enable the company to rubber-line open tanks of any size at the owner's plant or in the field.

FUSED PHOSPHATE FERTILIZER PLANT BEGINS OPERATIONS

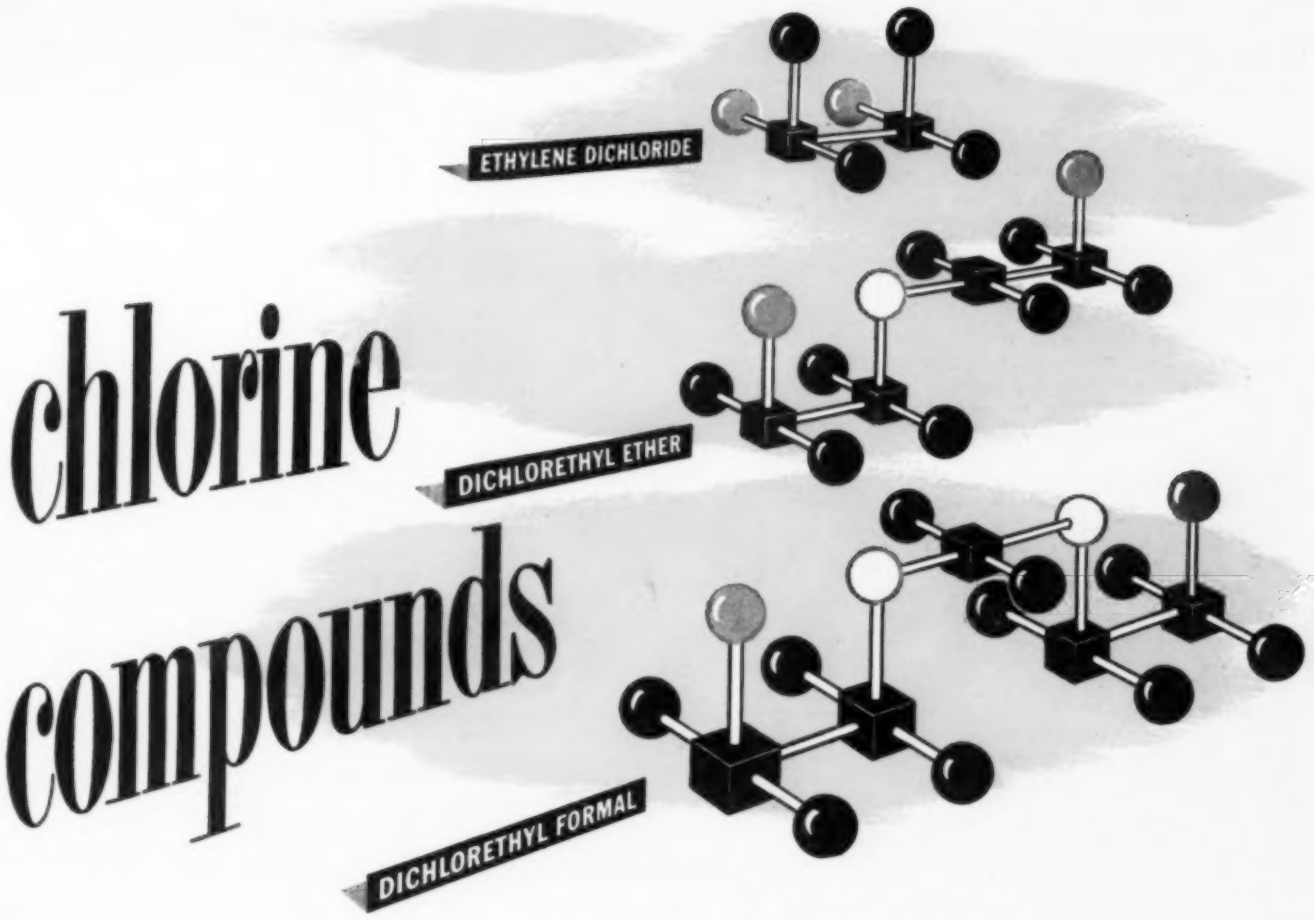
Now ready to begin initial operations is the new plant of Manganese Products, Inc., in Seattle which will produce a fused phosphatic fertilizer from phosphate rock and olivine in electric furnace operations. The process has already been carried through the pilot plant stage with a furnace having a capacity of four tons daily. After trying several types of furnaces, the direct-arc type was finally accepted as most satisfactory. The new commercial scale plant will have a daily output capacity of approximately 100 tons of fertilizer and will employ initially about 30 men on three shifts. The unit is located on a 7-acre tract having buildings formerly used as a steel foundry. Both rail and water transportation facilities are available.

Fertilizer to be produced will supply soil primarily with phosphorus and secondarily with magnesium. It is made by fusing phosphate rock and olivine in the proper proportion in an electric furnace at a temperature of about 1,400 deg. C. The furnace is of the direct-arc type and is 3-phase, 3-electrode, non-tilting and top-charging; it is capable of continuous tapping. The fertilizer contains over 20 percent available P_2O_5 (citric acid soluble) and 12-15 percent MgO. Although the waste gases contain fluosilicates, the firm is not planning to recover byproducts at present.

As a phosphate-bearing material, the new fertilizer most nearly resembles simple superphosphate but with some important differences: (1) Electric energy, which is plentiful in the Northwest, is used in the manufacturing process instead of sulphuric acid, of which there is no large excess production in the area; (2) the material has a somewhat basic soil reaction which makes it particularly applicable to soils on the Pacific Coast west of the mountains; (3) the product is of a granular, glassy nature, non-caking, non-injurious to plants in direct contact and not harmful to sacks or other containers; (4) it contains magnesium, which many western soils lack, and has 4-6 percent more P_2O_5 than most superphosphate.

Source of the phosphate rock will be from the firm's own mine at Philipsburg, Mont., which is now fully developed and ready to ship 100 tons of rock daily. Olivine will be obtained from Cypress Island, in the San Juan archipelago of Puget Sound, where millions of tons of hitherto undeveloped deposits are located. Manganese Products, Inc., owns the property on Cypress Island, so a supply of raw materials is assured.

The company, organized in 1937 for the purpose of developing a process for recovering manganese or its salts from low-grade,



chlorine compounds

Industrial Solvents — Chemical Intermediates — Agricultural Fumigants

The molecules represented here are some of the chlorinated organic compounds that have been developed by Carbide and Carbon Chemicals Corporation to meet the needs of industry and agriculture.

Chlorine compounds are widely employed as cleaning compounds, pharmaceutical extractants, dewaxing agents for refining lubricating oils, and solvents in resin coatings and rubber cements. They are valuable to the textile industry in kier boiling and degumming.

Chlorine compounds are useful as general industrial fumigants and as agricultural soil fumigants for the control of insect pests.

As chemical intermediates, chlorine compounds are used in the manufacture of acids, amines, nitriles, phenol derivatives, pharmaceuticals, yellow pigments, resins, and oil-resistant rubbers.

For further information about these compounds, call or write our nearest office for the booklet, "Chlorine Compounds" (Form 4769).

These are the chlorine compounds we produce:

ETHYLENE DICHLORIDE
"CHLORASOL" FUMIGANT
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ETHYLENE CHLORHYDRIN
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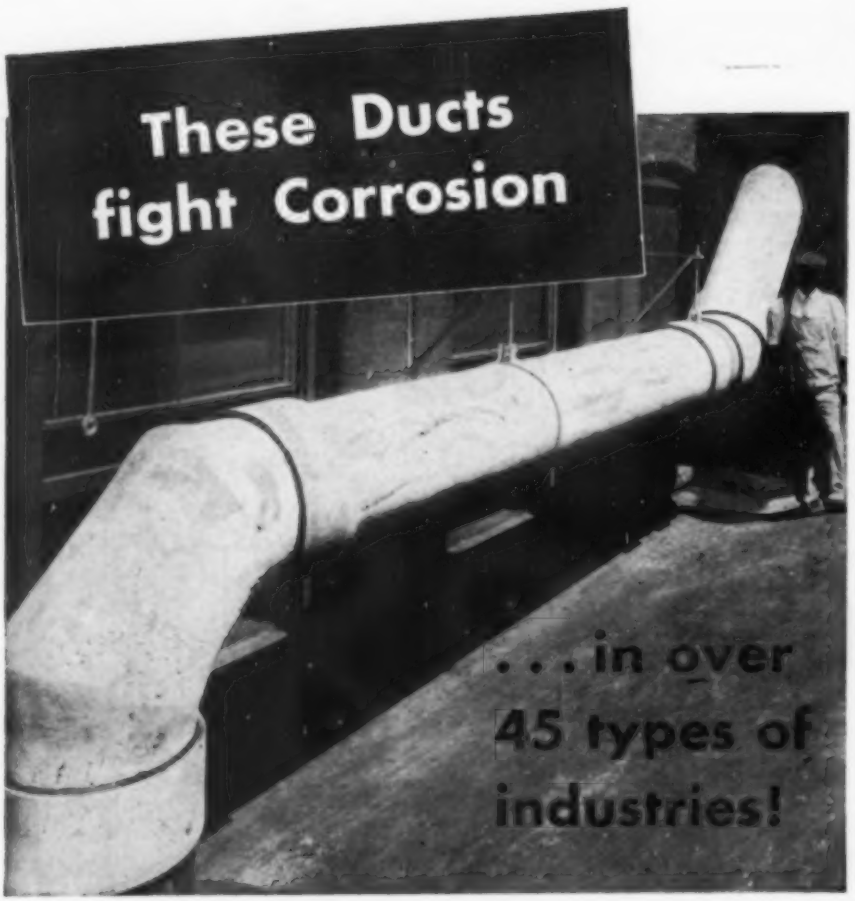


FOR many years, ducts, vents and stacks of Transite Industrial Vent Pipe have helped solve corrosion problems in more than 45 types of industries.

This strong, durable pipe successfully resists many of the corrosive fumes, vapors, dusts and gases encountered in industrial operations . . . providing effective and economical venting service.

Transite Industrial Vent Pipe is rustproof . . . highly weather-resistant . . . needs no paint. Made of asbestos and cement, it is light in weight . . . easy and economical to install. Available in sizes up to 36" in diameter, with a complete line of Transite fittings to assure corrosion-resistance throughout the system.

For details, write for Data Sheet DS-336. Address Johns-Manville, Box 290, New York 16, N. Y.

JM PRODUCTS

Typical industries in which Transite Industrial Vent Pipe is used

Aircraft	Dairy	Gas	Petroleum	Shipbuilding
Automobile	Drug	Glass	Potash	Shoe
Baking	Electrical	Laboratory	Pulp & Paper	Smelting
Bleaching	Explosive	Laundry	Quarrying	Soap
Boiler Works	Farm Machinery	Leather	Railroad	Soft Drink
Brewing	Food	Meat Packing	Rayon	Sugar Refining
Canning	Foundry	Metal	Refrigeration	Textile
Ceramic	Furnace	Mining	Rubber	Tool
Chemical	Furniture	Paint	Sewage Works	Water Works

Johns-Manville TRANSITE Industrial Vent PIPE

siliceous ores of the Olympic Peninsula in Washington, intends to carry on large pilot plant operations f r recovering manganese sulphate and oxides in conjunction with the new fertilizer works. Tecinnical director of Manganese Products, Inc., is now Dr. R. W. Moulton, associate professor of chemical engineering at the University of Washington. Superintendent of plant operations is Cyrus W. Richardson, while chief chemist of the firm is Norman Ketzlach.

NATIONAL LEAD INCREASES OXIDE CAPACITY

OUTPUT of lead oxides at the Oakland, Calif., plant of National Lead Co. will soon be increased by approximately 50 percent, according to K. J. Sanders, superintendent of the plant. Work on the expansion, which consists of a new steel-frame building 180 ft. x 45 ft. estimated to cost $50,000 without equipment, began in March; it is expected that the new unit will be in operation by mid-summer. Equipment for the expansion has been estimated to cost approximately $150,000. The Oakland plant of National Lead Co. produces red and white lead pigments and litharge or lead monoxide.

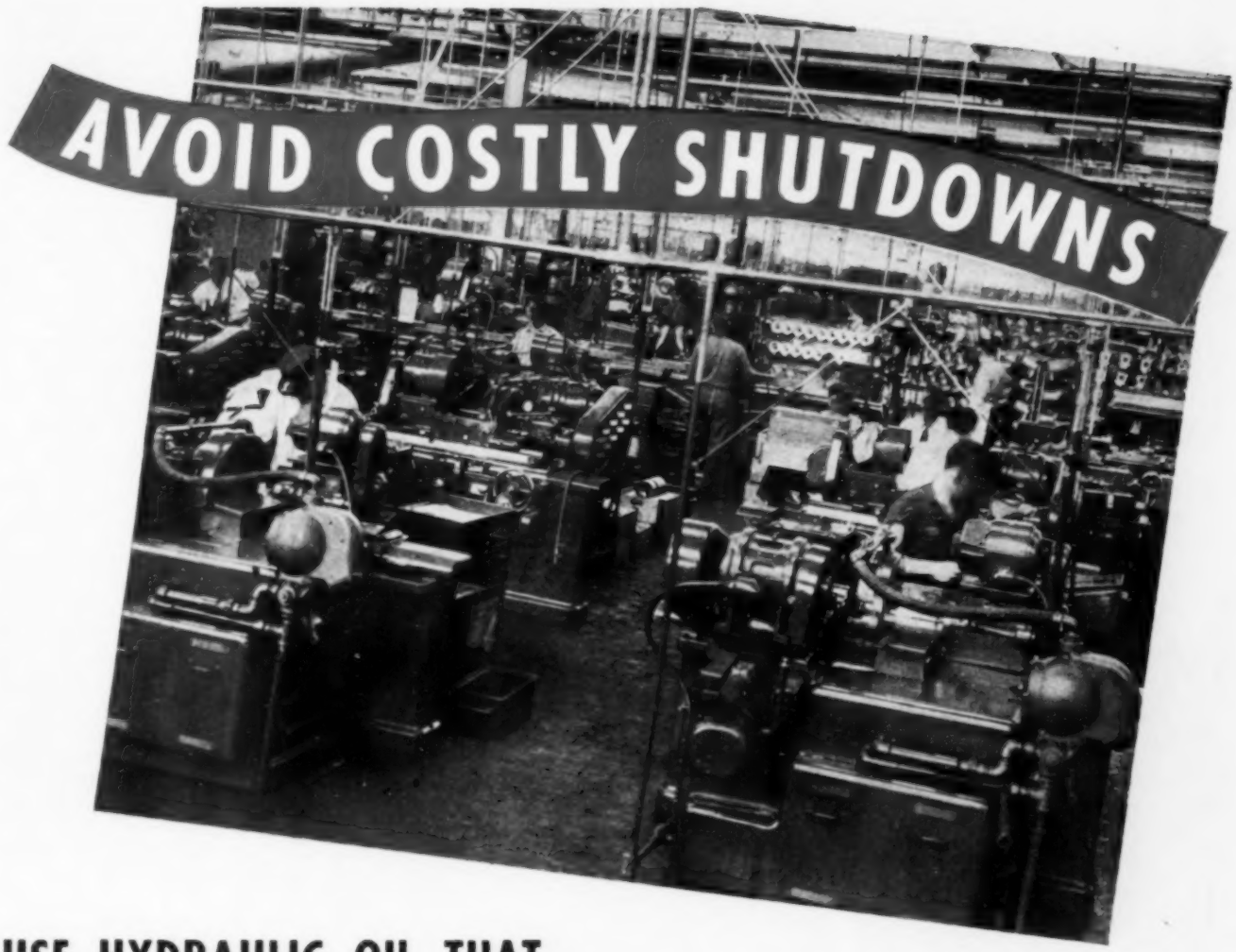
ELECTROCHEMICAL UNIT EXPANDED BY PENN SALT

PLANS for extension of the Portland, Ore., electrochemicals unit of Pennsylvania Salt Mfg. Co. of Washington have been announced by Glen E. More, superintendent of the plant. Cost of the expansion has been reported to exceed $1,000,000 and the firm made application early in May to the Civilian Production Administration for approval of construction valued at $940,000. In addition, considerable quantities of war surplus equipment have been acquired for the new units. Contract for construction of two buildings at a cost of $300,000 adjacent to the present plant has been awarded to a Tacoma firm.

Although chemicals to be produced in the new unit have not been officially announced, they will be produced by electrochemical operations. The present plant in Portland, also undergoing an expansion, has been producing potassium and sodium chlorates since 1940 (for a flowsheet of these operations, see *Chem. & Met.*, Nov. 1944, pp. 130-133). Sodium chlorate is extensively used as a weed killer in the Northwest. In addition, the firm operates a caustic soda and chlorine plant in Tacoma, Wash. Both the Tacoma and the Portland plants use solar-evaporated salt from the San Francisco Bay Area.

PLUTONIUM PLANT SWITCHES TO PEACETIME PRODUCTS

DECLARING that the importance of the Hanford, Wash., atomic energy plant "in its peacetime aspects lies principally in the field of power generation" and only to a limited extent in the chemical field, the War Department announced early in June that the $347,000,000 plutonium plant would be switched to peacetime operations under the management of General Electric Co. The plant has hitherto been operated for military purposes for the Manhattan Project by E. I. du Pont de Nemours & Co. for a total financial compensation in excess



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Texaco Regal Oils (R & O) free themselves rapidly of air and water. They prevent oxidation which is the cause of harmful sludge. They prevent rust by "plating" internal metal parts so that water condensations cannot reach them.

Furthermore, *Regal Oils (R & O)* do not foam. They resist the effects of high temperature and agitation, and keep wear at a minimum.

From the biggest presses to the smallest hydraulically-operated machines, *Texaco Regal Oils (R & O)* have proved their ability to assure smooth, dependable operation. Leading makers of hydraulic units ship their equipment with *Texaco Regal Oils (R & O)* or recommend their use.

Texaco Regal Oils (R & O) come in sealed drums, in a range to meet every requirement. Use them in your machines to assure trouble-free, economical performance. For full information, call the nearest of the more than 2300 Texaco distributing plants in the 48 States, or write The Texas Company, 135 E. 42nd St., N. Y. 17, N. Y.

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Made in a wide variety of cover styles and openings suitable for easy filling and safe airtight packaging of products.

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of expenses of one dollar. The plant has operated continuously from the time it first produced plutonium during the autumn of 1944. About 5,200 workers were employed.

In announcing the contract with General Electric Co. for atomic energy research and development, it was stated that the same financial arrangement as made with Du Pont would be retained under the new management. Little change is expected in personnel except for top officials. No hint was given as to the type of products General Electric expects to develop. Other than plutonium salts, the Hanford plant normally produces large quantities of low-temperature heat energy, byproduct uranium 238 largely depleted of its 235 isotope, radioactive iodine, barium and other elements produced in the pile operation.

SHELL CHEMICAL OUTPUT SHOWN IN REPORT

PRODUCTION of all chemical products during 1945 from the four chemical plants of the Shell organization reached 233,658 short tons, according to data just released in the Shell Union Oil Corp. annual report to stockholders. Sales of chemical products during the year amounted to 231,359 tons or some 99 percent of the year's production. Shell Chemical Corp. has made known its interest in expanding chemical operations, and Shell Development Co. recently announced an expanded research program (*Chem. & Met.*, April 1946, p. 174).

Total of all grades of aviation gasoline produced by Shell Oil Co., Inc. during the war period (Jan. 1942 to July 1945) reached 2,020 million gallons or 11.48 percent of the national total. Of this amount 1,890 million gallons were 100 octane or better, which was 13.10 percent of the total superfuel produced in the United States for the period. The accompanying table gives further data.

Chemical and Petroleum Manufacturing by Shell Union Oil Corp., 1945

Petroleum refineries	6
Intake for year (1,000 bbl.)	
Distilling crude	102,540
Cracking	61,163
Reforming	8,896
Refined products made (1,000 bbl.)	
Gasoline	51,005
Kerosene	4,684
Fuel oil	39,514
Lubricating oils	1,997
All other products	11,933
Total refined products	109,133
Natural gasoline plants*	24
Natural gasoline made (1,000 bbl.)	4,164
Chemical plants	4
Chemical products made (short tons)	233,658

* Including 10 partly-owned plants.

CHLORINATED SOLVENTS UNIT TO BE BUILT IN TACOMA

A NEW corporation known as Hooker-Detrex, Inc., jointly owned by Hooker Electrochemical Co. and the Detrex Corp. has recently announced that an $85,000 building will soon be erected in Tacoma for the purpose of producing chlorinated solvents. CPA approval has been granted for the necessary construction work and ground will be broken immediately. It is expected that production will begin by the end of 1946.

The new unit will be adjacent to the

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You'll save at every stage with Parker Tube Couplings. Here's why:

INSTALLATION is simplified—because the parts are self-aligning—and completely interchangeable, too.

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Parker Couplings are available in a wide variety of types—in steel, brass, stainless or aluminum—and in sizes from ⅛" to 1½", standard or heavy weight. You'll find complete information in our new catalog 201-C—yours for the asking, from your jobber—or write direct to The Parker Appliance Company, 17325 Euclid Avenue, Cleveland 12, Ohio. In Canada, Railway & Power Engineering Corporation, Ltd., Montreal, P. Q.

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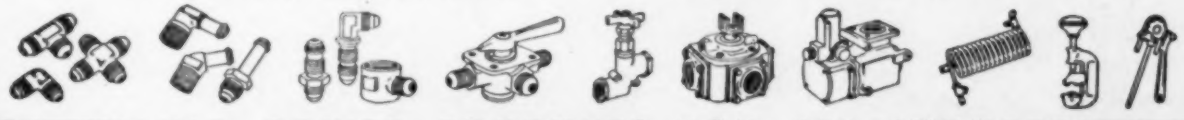

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No. 5 MIKRO-ATOMIZER — a self-contained small production unit requiring very little floor space.

A smoother material obtained by grinding your product finer than you have ever pulverized it before, may mean *new* products as well as new marketing possibilities for you.

The development of the MIKRO-ATOMIZER now makes possible the ultra-fine grinding of your product down to the 1 to 25 micron range (under 325 mesh). Others have found that this super fine grinding improved their products, helped provide *new* products, and opened the way to new markets.

You can investigate all the advantages of this ultra-fine grinding right in your own plant. You can purchase a machine for small quantity production, pilot plant or laboratory work, or you can get a larger size for full-scale manufacturing schedules.

No. 6 MIKRO-ATOMIZER for large production operations.

Send for your copy of new Advance Bulletin and learn how this radically new type of pulverizer may help you improve the smoothness and texture of *your* products.

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NOW . . . 2 TYPES TO MEET MOST PULVERIZING NEEDS

MIKRO-PULVERIZER (FINE)
MIKRO-ATOMIZER (ULTRA FINE)
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property now occupied by Hooker Electrochemical Co. in Tacoma where the firm produces chlorine, caustic soda, anhydrous $AlCl_3$, hydrochloric acid and hydrogen. The Detrex Corp., with main offices in Detroit, is a well-known producer of degreasing solvents and equipment, spray booths and drying ovens. It is understood that products of the new plant will be distributed to the maior West Coast markets.

Officers of the corporation include E. R. Bartlett as president, A. O. Thalacker as first vice president, R. L. Murray as second vice president, and G. E. Powers as treasurer. These men, with R. E. Emmett and H. M. Hooker, comprise the board of directors.

KAISER BUILDS GYPSUM UNIT AT LONG BEACH

CONSTRUCTION work is progressing on the new gypsum wallboard plant of Standard Gypsum Co. of California at Long Beach, Calif., first of several gypsum producing facilities to be built under an agreement between the Henry J. Kaiser organization and Standard Gypsum. The new facilities will incorporate the most modern methods of production and material handling. The mill will manufacture gypsum board products, including gypsum lath, and wallboard and exterior sheathing. The original Long Beach plant, which has produced plaster products for many years, is to be completely overhauled to manufacture all types of building and industrial plasters. Processing plants will secure gypsum from high-grade deposits located on San Marcos Island in the Gulf of California, Mexico, which have been estimated to contain some 500,000,000 tons of gypsum. The new and enlarged Long Beach facilities will help to alleviate the present shortage of building and industrial gypsum products.

THE PASSING OF A PIONEER

AFTER an illness of but a few months, Arthur R. Maas, president of A. R. Maas Chemical Co., South Gate, Calif., died June 2 at the age of 62. Mr. Maas, a graduate of the University of California and M.A. of the University of Southern California, was professor of pharmacy and toxicology at the latter university for nearly thirty years and also for many years head of a consulting laboratory in Los Angeles. In 1919, when the severe shortage of sodium sulphite and sodium hyposulphite threatened to interrupt production of films by the movie studios, he agreed to undertake the emergency production of these materials. He founded for this purpose the A. R. Maas Chemical Co. and as its business grew, he gradually shifted his interest from education to manufacturing, to which he gave all his effort for the last few years.

Mr. Maas was widely known in western chemical industry and was a leader in his profession and member of many clubs, societies and business organizations. He was a member for many years of the American Chemical Society and the American Institute of Chemical Engineers, having joined them when their California groups were small and helped them grow to their present strong positions.

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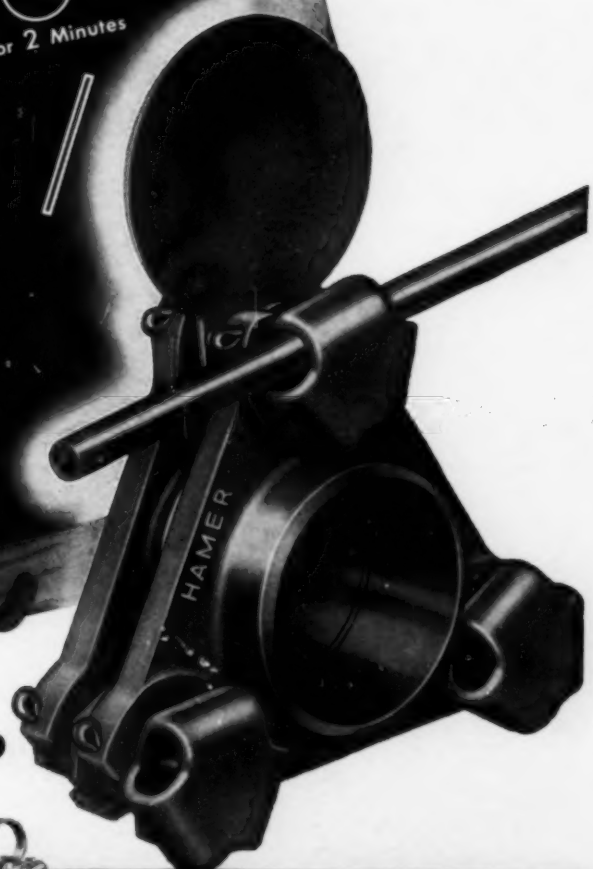
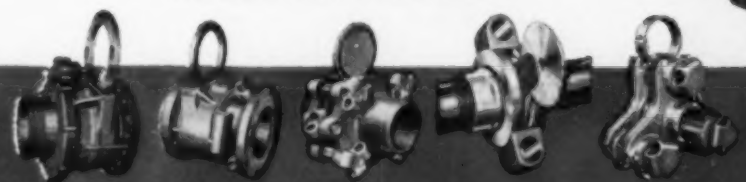


HAMER 3-BOLT LINE BLIND

HAMER LINE BLINDS



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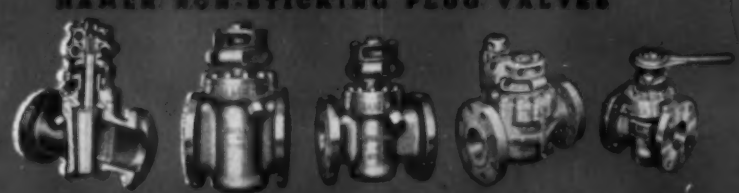

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NEWS FROM ABROAD

STEADILY MOUNTING PRODUCTION COSTS EXPECTED TO FORCE HIGHER PRICES FOR BRITISH CHEMICALS

Special Correspondence

THERE IS MORE evidence of further extensions in Britain's chemical industry. Though Lord McGowan supplied the shareholders' meeting of Imperial Chemical Industries with no further details of the £40,000,000 eight-year expansion program, other annual meetings of British chemical companies have provided new information about expansion and modernization schemes. Two pharmaceutical manufacturers, British Alkaloids Ltd. and British Drug Houses Ltd., report in unison that present raw material supplies and manufacturing facilities do not permit them to meet all demands.

The former states that if in the next 12 months it were allowed to obtain the plant and building licenses to carry out plans for expansion of production its overseas sales could be readily increased. The latter is issuing an additional £175,000 preference and £400,000 ordinary shares to repay a bank loan incurred to meet rapidly expanding demands and to increase further its manufacturing plant. A third pharmaceutical manufacturer, Evans Medical Supplies Ltd., has built new works for making organic chemical compounds for use in human and veterinary medicine. All these firms already are turning out increased quantities of various manufactures and looking forward to further advances in the near future.

Other sections of Britain's chemical industry present a similarly active picture. B. Laporte Ltd. reports that plants adapted for government orders have been returned to their original use, while at least some of the new factories built for manufacture of products not previously made in the country continue in production. The whole output of new sulphuric acid plant installed in 1941 and still in full production will gradually be absorbed by Laporte and one of its subsidiaries. The company remains very active in the field of barytes and barium compounds, while National Titanium Pigments Ltd., a Laporte subsidiary, is extending its plant to cope with larger raw material imports. For hydrogen peroxide, one of the principal Laporte products, new plant is to be erected at Warrington (Lancashire) as the Luton site has been developed to its maximum capacity.

The growing list of new chemical plant and extension projects naturally creates problems of its own, which have occupied the attention of the principal chemical manufacturers' and plant makers' organizations. The Association of British Chemical Manufacturers has suggested to the British Chemical Plant Manufacturers' Association that joint consulation take place between them regarding the delivery of chemical equip-

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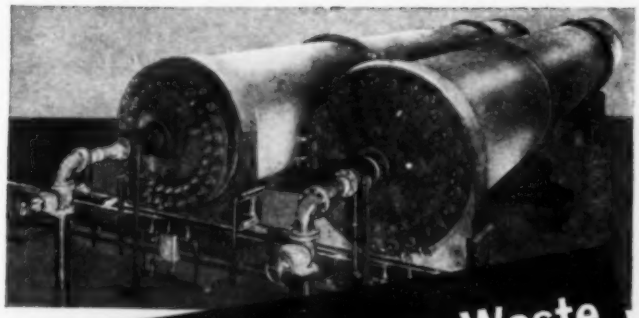

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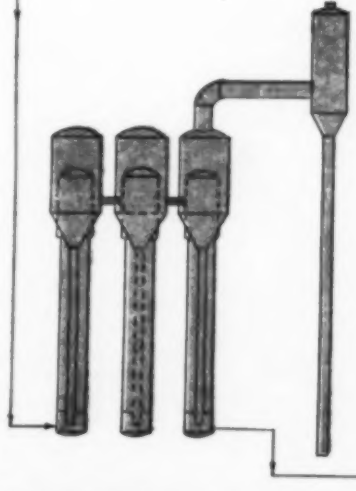

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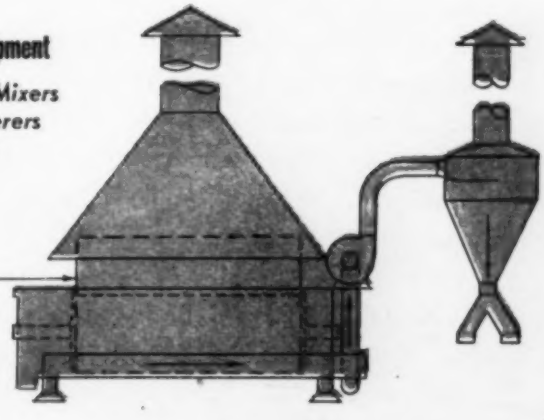

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ment. The A.B.C.M. has undertaken to ascertain the global requirements of its members. Meanwhile the B.C.P.M.A. has sent experts to Germany to investigate the suitability of German chemical plants for reparations. Certain claims have been filed as a result, more particularly in connection with the acquisition of know-how, designs, operating details, etc., but it is not thought that the transfer of actual plants to the British Isles would be of much assistance to English manufacturers. On the other hand, it is hoped that after the Anglo-American loan agreement has been passed and signed, United States plant makers will help to provide urgently needed equipment for British factories.

The wartime gap in plant maintenance and new construction for ordinary purposes tends to accentuate the difference in design and operating costs between prewar and new plant. Not only has recent research brought to light many novel and economical manufacturing processes but the shortage of fuel, the increased cost of labor and such general changes in the economic structure of the country as the trend towards regionalization have changed the economic conditions of chemical production. There is thus a need for quicker writing-off of plant investment values, not only in the younger but even in some of the old-established branches of chemical production. All cost elements—raw materials, fuel and power, wages and expenses—have been rising at an accelerated rate of late. These factors cannot long remain without a notable effect on the chemical price level.

PRICE ADVANCES

So far price advances have come chiefly from the raw material side, sometimes on direct orders of government departments in charge of their control, while private manufacturers have been notably reluctant to raise their quotations. In some cases the hope that larger sales will offset increased costs may have caused producers to go slow with price increases at this critical transition stage, but in others advances have been omitted out of fear that they might endanger the companies' competitive position. Smaller firms, in particular, have been most reluctant to raise their quotations while their rivals abstained from a policy of higher prices. It is therefore of particular interest that Lord McGowan as head of the leading chemical combine warned against the repercussions of higher producing costs in terms which left little doubt that an early if gradual rise of British chemical prices must be anticipated.

The month of May brought the anticipated further rise in chemical exports after the slight setback, due to the Easter holidays, in April. The June figures are unlikely to show any substantial further gain, because of the Victory Day and Whitsun interruption, but even so it is virtually certain that the total figures for the first half of 1946 will show an increase in British chemical exports to three times the prewar level.

In future the difficulties of obtaining new plant and effecting plant repairs may slow down the expansion, but several of the leading firms intend to make up for this by extending local factories by their own subsidiaries in overseas territories. Pinchon Johnson & Co., British Oxygen and B.

For All Heat Transfer Applications

up to 700°

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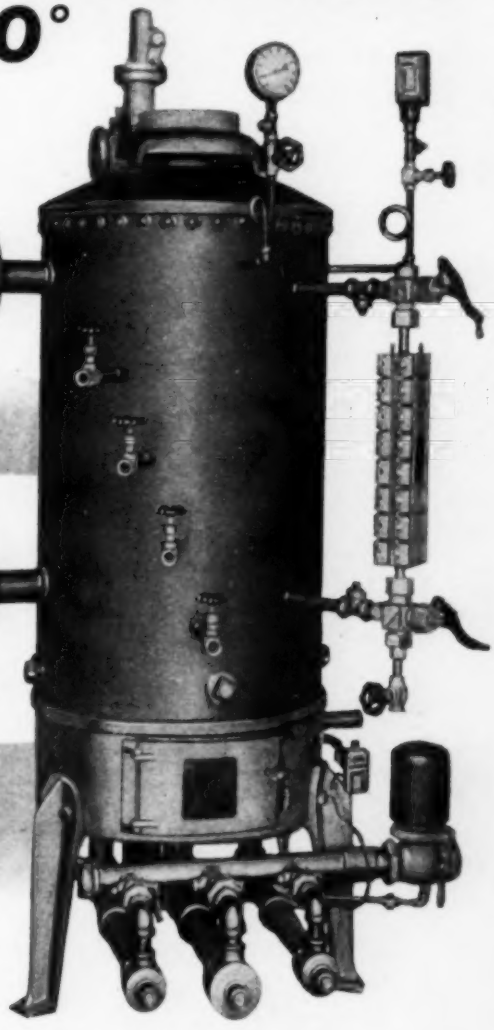

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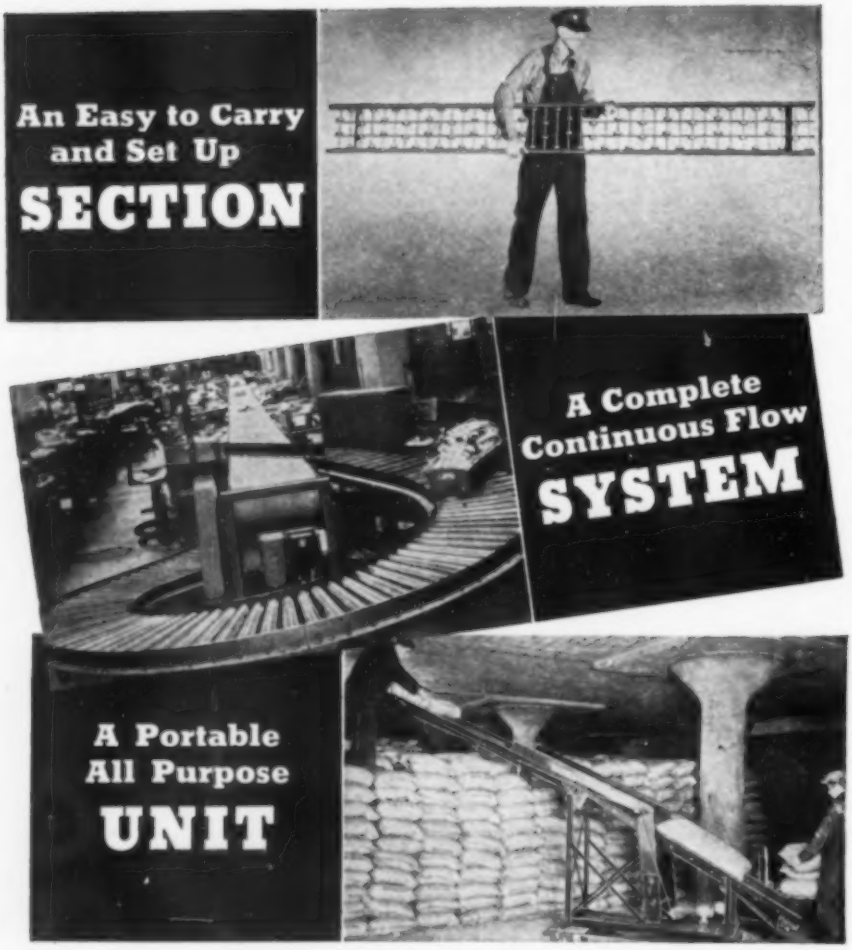

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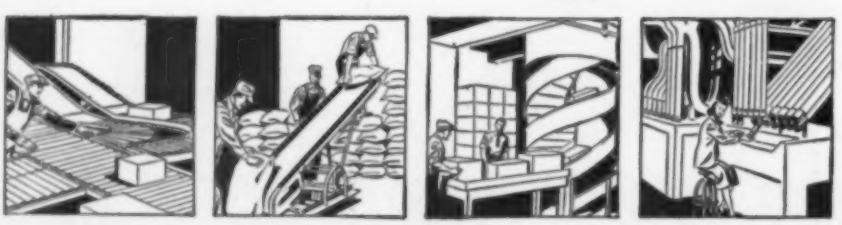

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Laporte, to give three prominent examples, all expressed their intention to extend overseas manufacturing activities, partly in connection with the marketing of British home-produced chemicals and allied products in these regions. Most of these projects are concerned with British Empire territories and, in particular, with the Dominions whose mounting industrial capacity creates new opportunities for chemical manufacture on the spot.

Trade with continential Europe is rapidly expanding since more permanent commercial and financial arrangements have been made. All the liberated countries present an almost inexhaustible market as stocks have been used up. France, Denmark, Spain, Eire, Belgium, Holland and Sweden are the leading buyers of British chemical manufacturers in Europe, according to the latest available returns, but a substantial part of this is still due to relief shipments. More assured currency conditions gradually permit relaxations in import controls, with the result that larger quantities of various chemical products are now coming into England from continental and other sources. It is hoped that this will help to ease the tight position in certain sections of the British market. For certain paint materials, for instance, the authorities have been forced to reintroduce export restrictions, while generally paints are to be made the object of an official allocation scheme. Where new plant is urgently needed to meet vital requirements the present system of licensing unfortunately involves long delays, with the result that some new plant capacities, urgently needed in the next few months, will not be available for regular production until the beginning of next year.

Penicillin can now be bought freely on doctor's prescription in chemists' shops since production has reached the stage where the whole domestic demand can be met. Production at the two big factories at Speke and Barnard Castle has been so successful that earlier output schedules have been surpassed. Soon a surplus for export will be available, especially when the big factory at Ardrossan (Ayrshire) comes into production in July or August. Several thousand workers will be employed in the production of penicillin, while the plants cost about £3,000,000. The total output may well attain 500,000 mega-units before long and latest research results suggest that further output gains will be secured without additional expenditure on plant.

LONG-RANGE DEVELOPMENT PLAN FOR INDIA

Special Correspondence

LEADING industrialists and economists of India have drawn up a 10,000 crore-rupee plan ($30,000,000) popularly known as "Bombay Plan" envisaging industrial and agricultural development of the country on an unprecedented scale in the next 15 years. The plan has aroused wide interest and some of its important features have been incorporated in other parallel plans which have been devised by the government and other agencies. The government has created a new Department of Industrial and Development under whose auspices more than a dozen panels covering all the important industries, including metallurgical, chemical,

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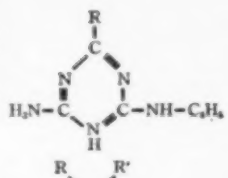
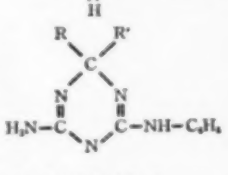
Phenyl biguanide can be used as an intermediate in the preparation of heterocyclic organic nitrogen compounds—mainly six membered rings containing two or three nitrogen atoms. For example, it reacts with:

Formamide, esters, and acid chlorides yielding substituted 4-N-phenyl guanamines



Aldehydes and ketones yielding diaminodihydro triazines



Phenyl biguanide hydrochloride is currently available in research quantities from our pilot plant. If your investigations indicate the use of one of the other aryl biguanides, we will be pleased to discuss with you the availability of ortho-tolyl and para-nitro-phenyl biguanide.

PROPERTIES	
Pure phenyl biguanide hydrochloride	
Form	White powder
Melting Point	237°C.
Molecular Weight	213.5
Solubility	Insoluble in cold water
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Part of plant expansion program the Guanos y Fertilizantes de Mexico, S. A., has under construction at San Luis Polosi, S. L. P., a contact sulphuric acid plant and a superphosphate (Chemical Construction Corp. has the contract) and a bonemeal plant at Mexico City. The company plans to add an ammonia plant immediately and will produce ammonium sulphate for the fertilizer trade

drugs and pharmaceutical, engineering, plastics, textiles, electrical and electrochemical, are busy working out details for the development of the respective lines.

These panels, after a survey of the present status of the industries have indicated the lines in which their expansion should proceed, the targets of production, the types of equipment required, and the possible sources of supply. The Industrial Plant and Machinery Panel set up by the government to examine the possibilities of manufacture within the country of textiles, sugar, chemicals, paper, cement, and machinery and equipment, is being advised by the engineering firm of Ford, Bacon & Davis of New York.

Indian industrialists also have taken steps to bring about the establishment of new industries. Several industrial delegations have visited the United States and the United Kingdom to study the latest scientific and industrial progress made in those countries, to contact manufacturers of plants and machinery who will be in a position to meet the demands of Indian requirements. In some cases they have actually negotiated for supplies. As a result some of their plans have taken final shape.

Indo-British and Indo-American combines (Birla-Nuffield and Walchand-Chrysler) have been formed for the manufacture of automobiles in India. The Tata-Imperial Chemical Industries has made headway in the manufacture of dyestuffs and intermediates. A large fertilizer plant capable of producing 35,000 tons of ammonium sulphate a year will be built with American and British equipment and run with their technical help.

Rayon, shipbuilding, metallurgical, chemical, and aircraft industries are among others for which final plans have been drawn up. The Central Technical Power Board, advised by American experts, has proposed the harnessing of the water resources of the country for power for industry, for traction, and for agriculture. A noteworthy instance of this enterprise is the Damodar Valley Project to be developed along the lines of the American Tennessee Valley Authority.

The inauguration of the Council of Scientific and Industrial Research in 1942 marked another step in the country's industrial development. During the short period of its existence the council gave great impetus to the war effort of the country on the scientific side and has focused attention on the importance of research in industry. Five National Laboratories, National Chemical Laboratory, National Physical Laboratory, National Metallurgical Laboratory, Fuel Research Institute and Central Glass and Ceramic Research Institute are shortly coming into being and the government has voted a large sum of money for the development of these laboratories and for scientific and industrial research, on a very generous scale. A large batch of Indian students has been sent to U. S. A. and U. K. for specialized training in science and technology who on return will man the country's industry.

LARGE FRENCH APPROPRIATION FOR AMERICAN EQUIPMENT

Plans for expanding and modernizing the French chemical industry, given the green light by conclusion of the $1.4 billion Franco-U.S. credit agreement, call for imports of $20 million in capital goods into France during the next four years. Of the $20 million total, about $15 million is tentatively scheduled to be spent for U.S. equipment, McGraw-Hill World News has learned.

When the new French facilities come into production, it is hoped that imports of finished chemicals may be reduced. The chemical equipment purchases will be coordinated with France's over-all five-year reconstruction plan, drawn up by Jean Monnet as head of the Commissariat du Plan de Modensation et d'Equipment, and designed to increase the total national output to 25 percent over the 1929 level by 1950.

The French Supply Council, a French government agency with offices in New York

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The *single* Morflex handles shaft misalignment up to 5°; the *double* Morflex handles extreme misalignment. There is a Morflex Coupling to fit your needs and cost requirements . . . and available in quantity!

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and Washington, will be the best source of information about specific equipment desired.

ITALY OFFERS PATENTS ON BERYLLIUM ALLOYS

American industry is being offered patent rights on an Italian secret process for producing marketable beryllium alloys—both copper and aluminum—without reducing the element, the Economic Section of the U. S. Embassy in Rome reveals. The process is owned by SAPPI (Societa Anonima Processi Privati Industriale) and has been used successfully at a factory built at Chivasso near Turin in 1936. The Germans operated the plant and exported all its output from 1940 until the end of the war. Interested firms should contact the principals through the Embassy Economic Section.

AUSTRALIA WANTS GERMAN HYDROGENATION PLANTS

Australia plans to establish a plant for the extraction of oil from coal. Australia's scientific mission in Germany has been specially interested in the hydrogenation process. It has reported that a number of hydrogenation plants would probably become available to Australia as reparation payment. The value placed on the plants would be high and would make up a large proportion of the total reparation to Australia.

It would probably be necessary to transfer to Australia trained personnel to erect and operate the plants. The size of the machinery would make shipment to Australia a big problem. While the result of the United Nations talk on war reparations was being waited, the mission was sending to Australia all technical data available. Even if the plants were not shipped it might be possible to build hydrogenation machinery from the technical data obtained from Germany. The proposed site of the plant is at Ellalong, near Cessnock, New South Wales, a very good coal bearing area of excellent quality coal.

SULPHUROUS MILK PRODUCED FROM COAL IN INDIA

Reports from Lahore, India, say that by low-temperature carbonization of the high-sulphur-content coal found in the Punjab an Indian scientist, Dr. R. D. Bhattacherjee, has separated out a sulphurous "milk" useful in producing sulphuric acid. A byproduct of the process is a low-temperature coal gas. Dr. Bhattacherjee was formerly chief research chemist of Tata Iron and Steel Co. and is now the Punjar Government's research expert on industrial utilization of coal.

PLASTICS PLANT COMPLETED AT SHAWINIGAN FALLS

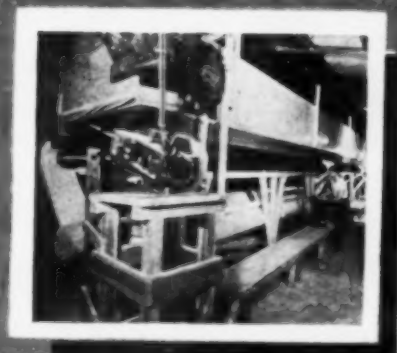
Installation of machinery and equipment is reported to have been completed last month at the new plastics fabricating plant of Canadian Resins and Chemicals Limited at Shawinigan Falls, Canada. This company, which is jointly owned by Shawinigan Chemicals Limited and Union Carbide & Carbon Corp., started manufacture

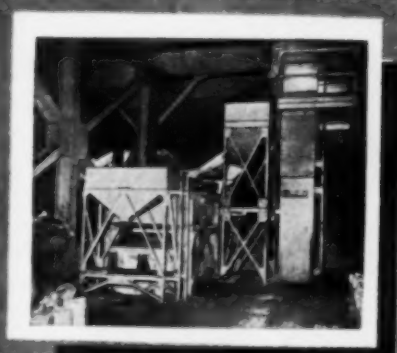
JEFFREY TRAYLOR

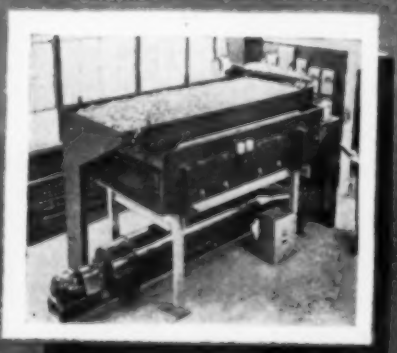
ELECTRIC VIBRATING DRYERS

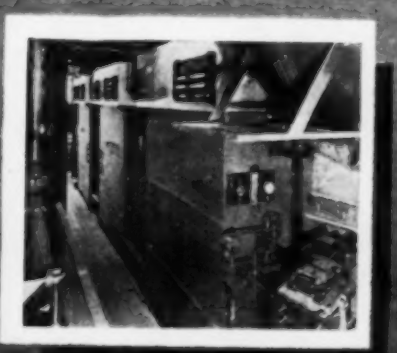
(PATENTED)

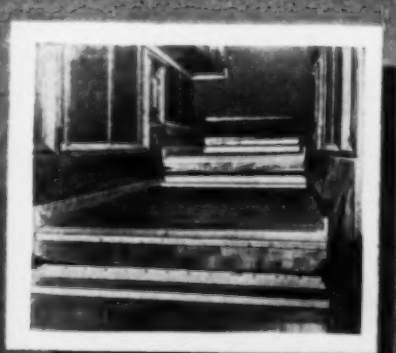
A Few Typical Installations

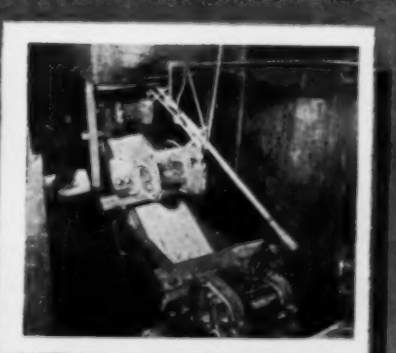












THE JEFFREY MANUFACTURING COMPANY

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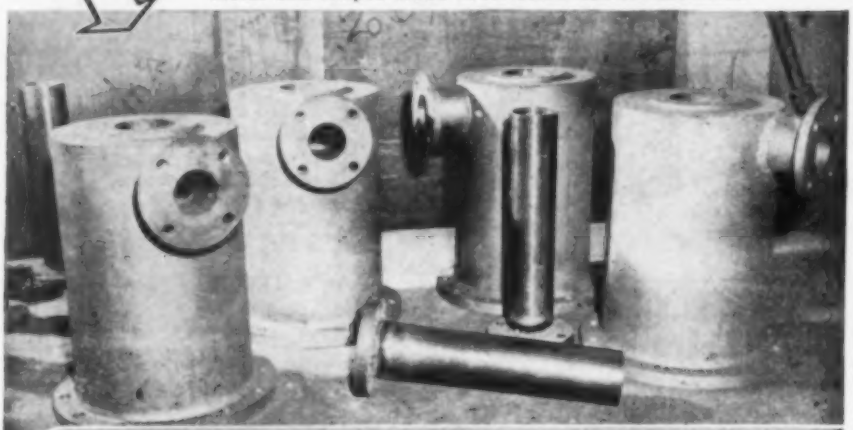
ESTABLISHED 1877

These condensers are typical fabricating applications of Ampco Metal and Ampco-Trode in corrosion-resistant assemblies.



Longer life... lower cost... on units for processing corrosive substances

... when they are fabricated from

AMPCO METAL

... and welded with

AMPCO-TRODE

COATED ALUMINUM BRONZE ELECTRODES

Durable assemblies of Ampco Metal and Ampco-Trode stand up under difficult conditions:

...In the routing of liquids, semi-fluids, and liquids containing solids in suspension, such as

- Acids
- Petroleum sludge
- Alkaline solutions
- Sea water
- Mine waters
- Food product liquors
- Hot brine

...Under varied conditions of

- Corrosion
- Velocity
- Temperature
- Pressure
- Consistency

P-10

In the original construction of complete units subject to the destructive action of caustics and acids — as well as fabricated parts — this combination has proven successful on a wide variety of applications:

Ampco Metal — an engineered aluminum bronze alloy of controlled quality that provides definite advantages: High tensile strength. Good ductility. Less weight. Desirable hardness, to resist corrosion, erosion, abrasion, and cavitation. Available in five grades and several modifications — as castings, forgings, sheets, rods.

Ampco-Trode — coated aluminum bronze electrodes that deposit weld metal comparable in physical properties with the five grades of cast Ampco Metal.

Ampco's nation-wide organization of field engineers is ready to help you with recommendations based on successful experience in solving corrosion-resistance problems. Call on us. Write for bulletins.

AMPCO Metal
The Metal without an Equal

Ampco Metal, Inc.
Department CM-7
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Field Offices in Principal Cities

of Vinylite resins in Canada in 1943. The new unit will further process the resins to produce plastic film and sheeting of various thickness and colors as well as extrusion and molding compounds.

CZECH COMPANY PRODUCES COAL-TAR CHEMICALS

THE Stalin Works at Most, Czechoslavakia, are producing a large number of coal distillation byproducts from poor quality coal obtained by surface mining. Dr. Jaroslav Tichy, head of the Stalin Works and deputy general director of the nationalized Czech chemical industry, said it is hoped that Prague will be supplied with coal gas from the Most works this winter by means of a 45-mile pipeline. The Stalin Works eventually is to utilize the entire output of the North Bohemian coalfield.

NEW LIME PROJECT FOR BRITISH COLUMBIA

DEVELOPMENT of a new lime products industry will be undertaken by British Columbia Minerals and Resources Development Co., Ltd., according to an announcement by its president, David S. Tait. The company has acquired a 500-acre deposit of exceptionally pure limestone on Texada Island and a distribution site has been acquired at New Westminster fronting on the Fraser River. Mr. Tait said orders already had been received from British Columbia consumers and that a United States farm cooperative was ready to place an order for 25,000 tons.

CHILE SPEEDS UP SODIUM NITRATE OPERATIONS

A REPORT from the McGraw-Hill World News Bureau says that Chilean nitrate shipments have shown an amazing comeback in the past month with two processing plants in the northern part of the country, closed for the past ten years, put back into operation with a total employment of more than 3,500 men. Possibility of a boom is seen as a result of the visit of Herbert Hoover who advised the Chilean government it should do everything possible to ship nitrates to Europe to take the place of synthetic fertilizers formerly produced in bombed-out chemical plants.

NEW COKE OVEN BATTERIES PLANNED FOR RUSSIA

THE Soviets' new five-year-plan calls for rehabilitation, construction or starting of 63 coke oven batteries. One new set of two ovens to produce 500,000 tons annually is planned as part of a new vertical steel combine in the Georgian S.S.R. How much use will be made of byproducts from these new ovens is not clear from recent reports.

SWEDISH CELLULOSE CO. TO MOVE HEADQUARTERS

THE Swedish Cellulose Co. will transfer its headquarters, though not its sales office, from Stockholm to Sundsvall, near which many of its mills are located. The transfer will take a year or more to complete. The company's mills now have an annual pro-

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MOTORS

GEARED POWER FOR INDUSTRY

THROUGHOUT America, in great and small production plants alike, wherever power turns the wheels of industry—Sterling Slo-Speed (Geared) Motors are leading the way to increased production records.

Sterling Slo-Speed (Modern Gear System) Motors give machinery manufacturers and production executives a complete power drive in one soundly engineered—compact—flexible—ultra efficient unit.

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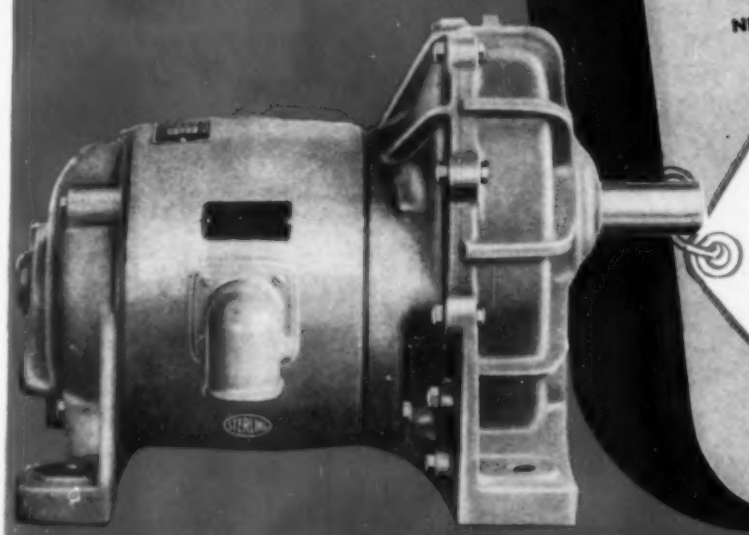


WRITE YOUR OWN TICKET

H.P.—From 1/2 to 15

GEAR RATIOS—From 3:1 to 50:1

STERLING ELECTRIC MOTORS

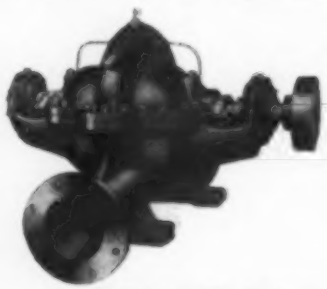
for Greater Perform-ability

PEERLESS
Centrifugal
PUMPS
(FORMERLY DAYTON-DOWD)

For
INDUSTRIAL USES

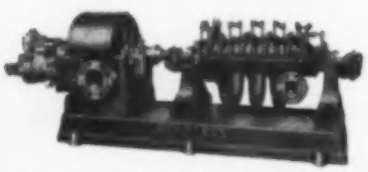
CAPACITIES TO 60,000 G.P.M.
A COMPLETE RANGE OF
SIZES AND TYPES

PEERLESS TYPE "A"
FOR GENERAL PURPOSE PUMPING



Split Case; Single-stage; double suction; sizes: from 8" to 42"; capacities: up to 60,000 g.p.m.

PEERLESS BOILER FEED TYPE "B" PUMP



Designed particularly for bolier feed, oil refinery and pipe line service. Pressure: to 700 lbs.; sizes: 2½", 3" and 4". Multi-stage, automatically balanced type.

Peerless Centrifugal pumps are adapted for use in a wide variety of services including municipal, paper mill, sugar mill, mining, filtration, irrigation, chemical processing, food and refrigeration uses. Descriptive engineering bulletins available.

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duction capacity of 250,000 tons of sulphite pulp, 110,000 tons of viscose pulp, 350,000 tons of sulphate pulp, 170,000 tons of mechanical pulp, 40,000 tons of newsprint, and 200,000 standards of wood goods. Payment of the company's first dividend has been recommended by the directors.

RUSSIAN DEVELOPS METHOD FOR TESTING ALLOYS

Discovery of a rapid shortcut in the formation and testing of alloys is claimed by a Russian engineer, Sergei Vekshinsky, who headed the research department of the Leningrad Electric Lamp Factory during the war.

Instead of studying the properties of alloys in their static shapes, a process involving preparation of innumerable samples, Vekshensky's method permits the researcher to run through a whole range of variations of any combination of metals at once, according to Moscow press reports.

It consists of heating two metals to incandescence in a vacuum, then mixing the streams of particles emanating from them and catching them on a screen for examination. The result is sort of a metal spectrum. Vekshinsky says the center of the strip traced on the screen by the outpouring of particles consists of equal quantities of each of the metals, while on one side one of the metals evenly and gradually increase in quantity and on the other decrease equally steadily.

The result is a full range of the combinations possible to devise with the two metals. Use of the method recently in checking copper-aluminum alloys is cited. Hundreds of tests which would have required at least three months under previous methods were completed in less than a full working day. In the case of alloys of five or six metals, it is said, the time-saving is measurable in man years.

GERMAN CHEMICAL INDUSTRIES

PRODUCTION OF BERYLLIUM AND BERYLLIUM COMPOUNDS

Beryllium ore is ground in a rotary ball mill and sifted, mixed in a drum with chalk amounting to 30 percent of its weight. The mixture is heated in a rotating furnace to about 1,400 deg. C. and this charge is cooled in water, and the substance is then dried and ground. 300 kg. of this charge is mixed with 480 kg. sulphuric acid of 60 deg. Be. in an iron pan, and brought to reaction by adding water. The mixture is stirred by hand. The resultant crumbly mass consists of sulphates of chalk, beryllium, aluminum, iron and silicon oxide.

Sulphated charges (420 kg.) are reheated with 320 litres of water in a steam jacketed and leaded mixing vessel. The solution is filtrated and the residue ($CaSO_4$ and SiO_2) is washed.

The solution is put into a leaded crystallizing pan with addition of 75 kg. ammonium sulphate. The largest part of the aluminum is separated by centrifuging, as ammonia alum during cooling. The remaining solu-

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ARE
NO PROBLEM!

NOW "TEAR DROP" flows as low as 5 cc per min. can be remotely—
INDICATED
RECORDED
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with the newly developed F & P
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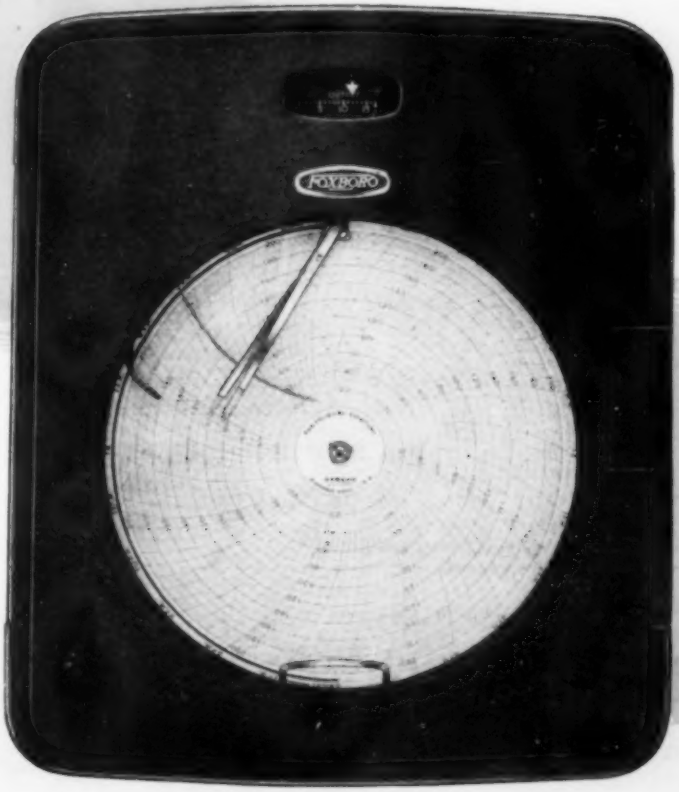
electronic amplification of the
Rotameter float position
WRITE FOR CAT. 52-A

FISCHER & PORTER COMPANY
HATBORO, PENNA.—DEPT. 2-98

Every known requirement of leading industries, every proved scientific advance in pneumatic control, every advantage of unmatched research and experience, has guided the design of the new Foxboro Model 40 Stabilog Controller. The results are simpler and more rugged construction, easier and more stable adjustments, unequalled performance.

Foxboro 40

STABILOG* CONTROLLER

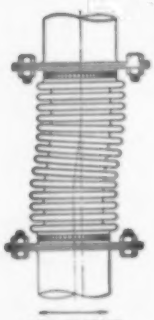


Write for complete explanation in Bulletin 381. The Foxboro Company, 16 Neponset Avenue, Foxboro, Mass., U.S.A.

* Reg. U. S. Pat. Off.

Expansion Joint

C. M. H. STAINLESS STEEL BELLOWS



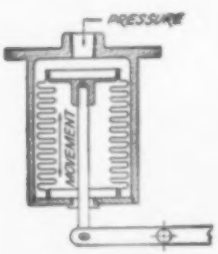
Flexible Connector

Assure

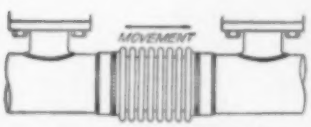
long life
low maintenance

The outstanding features of corrosion-resistant 18-8 Austenitic *Stainless Steel* enable wider application of C. M. H. Bellows. This is because *stainless steel* has the necessary characteristics to assure long life and low maintenance cost.

C. M. H. Bellows, for example, with a working range of sub-zero to a scaling-point of 1800° F. are not bothered by temperatures . . . hot or cold. In addition, they have multiple-ply construction for greater strength; ferrous fittings, attached by Circular Seam Welding to insure leakproof joints; uni-metal assemblies which avoid troubles often encountered when bi-metal or solder joints are used. These and other features warrant your consideration. Write for Bulletin SS B-46.



Pressure Motor



Compensator for Headers

Flexible Metal Hose for Every Industrial Use

CMH CHICAGO METAL HOSE CORPORATION
MAYWOOD, ILLINOIS
Plants: Maywood and Elgin, Ill.

tion still contains iron. To de-iron, the solution is diluted, heated and mixed with hydrogen peroxide, with addition of 75 kg. calcium carbonate. Samples are taken and examined to determine whether precipitation is complete. The solution should show a pH of 3.8 to 4.2.

The solution is further diluted and the beryllium hydroxide is precipitated by the introduction of ammonia. The hydroxide contains approximately 6-7 percent BeO after filtrating. This is dried in muffles and then contains 50 percent of BeO.

For the production of technical oxide, the hydroxide is calcinated in a tubular furnace.

For the production of chloride approximately 100 kg. hydroxide are mixed with 60 kg. charcoal; 15 kg. of this mixture is mixed with 5 kg. of wood tar and 5 litres of water. The crumbly mass is pressed in a hydraulic press in such a manner that the material comes out of two openings in the form of small rods as thick as fingers. This is dried and calcinated in a tubular muffle furnace. It is chlorinated in an electrical furnace and the fingers themselves serve as conductors of the alternating current; two of the furnace walls are formed by the two carbon electrodes. An excess of chlorine is introduced from below and the saturated chloride is collected in nickel pans. This is cleaned by re-sublimating under hydrogen.

The electrolytic production of beryllium is carried out in nickel pans, which serve as cathodes; the anode is formed by a graphite rod which enters at the center of these pans. The electrolyte contains approximately 50 percent $BeCl_2$ and 50 percent NaCl. After an electrolysis lasting for 24 hr., the electrolyte is sucked into another pan and the segregated metal is removed. The excess electrolyte is removed by compressing the metal.

The mixture of solid metal and liquid is put into ice water, and the adhering electrolyte is dissolved out. The metal is washed with a mixture of diluted caustic soda and nitric acid and dried. The recovery of metal from beryl ore is a little under 50 percent.

The health of workmen engaged in beryllium production is likely to be affected and cases of death have occurred. The toxic action is said to be particularly acute in the fluoride process, which had been discarded as much as possible in favor of other methods, but even these other methods were still harmful. There had been 8-10 deaths in about 9 years at Degussa. Methods of mitigating the sickness, was to build roomy workshops with more than usual ventilation facilities, and to insist strictly on the wearing of masks as well as to have a system of rotation, so that the workmen are taken to another job after three months.

Digest from "Magnetic Materials and Beryllium," by E. M. Foster.

RAPID DETERMINATION OF Cu IN Al ALLOYS

In a 200 cc. volumetric flask 0.5 g. shavings (sample) are placed, dissolved in 10 cc. caustic soda solution, boiled for 3 min., diluted with 20 cc. H_2O, acidified with 15 cc. citric acid and 30 cc. HNO_3, and boiled for a short time. After cooling to about 50 deg. C., 100 cc. ammonium hydroxide, is added, cooled to room temperature, and filled to the 200 cc. mark with water and well mixed. The turbidity is removed by filtering.

HOW TO

GET MORE WORK

out of steam heated process equipment

NOW is the time when it will pay you to check up on the production efficiency of your processing equipment. Increasing operating speed and reducing heating time will help you meet the rise in manufacturing costs.

Armstrong Steam Traps are helping manufacturers get more work out of their power plant equipment because:

1. They remove condensate as fast as it is formed.
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Write for a copy of Armstrong's 36 page Steam Trap Book, and the name of your Armstrong Representative.

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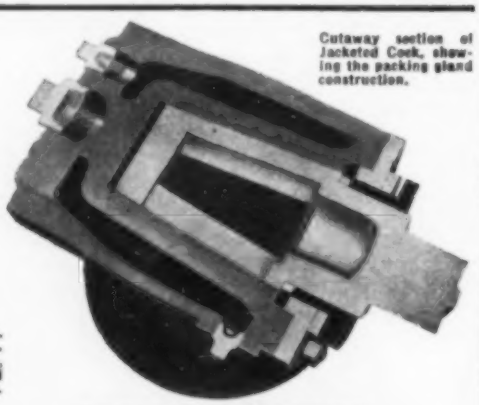
HETHERINGTON & BERNER

JACKETED PIPE and FITTINGS



Cutaway section of Jacketed Cock, showing the packing gland construction.

Typical arrangement of jumpover connections, using standard pipe and fittings.

FOR MAINTAINING UNIFORM TEMPERATURES

(Hot or Cold)

Wherever the maintenance of a uniform temperature in the process pipes is required, Hetherington & Berner Jacketed Pipe and Fittings make for efficient processing. This is equally true whether the processing requires a hot or cold temperature, and whether the heating medium is hot water, steam, or hot oil. Materials which at atmospheric temperature are in a solid or semi-solid state can also be efficiently handled with a H & B jacketed pipe system.

Write for Bulletin S-44, which gives complete information.

HETHERINGTON & BERNER INC.

705 Kentucky Avenue Indianapolis 7, Indiana

using filter aid and 100 cc. is placed in the photometer.

Basis for this rapid works method is the formation by copper of a deep blue tetramine complex in the presence of citric acid. Range of usefulness is 0.3-6.5 percent copper with an accuracy of 2.4 percent of the found value. Co and Ni over 0.5 percent give excess values.

Time required is 10-12 min. and, by series operation, it is possible to make 100 determinations in 8 hr.

Digest from "Vereingte Leichtmetall Werke G.M.B.H. Hanover Linden," by A. E. Link. (The report also contains directions for determination of Mn in Al and Mg alloys, Mg in light metals, Si in Silumin, Fe with $KMnO_4$, Fe with sulphosalicyl acid in Al and Mg alloys, Zn in Al and Al alloys, Cr in Al alloys, and V in Al-Zn-Mg alloys in the presence of Cu.—*Editor.*)

ALUMINA FROM CLAY

During the later years of the war, studies were made of the reduction of aluminum from clay. The single motive was, of course, the desire for independent sources of this important material of war. The most promising process and the one given production scale demonstration using local clays was that which would employ the I. G. Farben 500 ton-per-day cement plant at Wolfen. Little additional aquipment to that already in use was needed.

A mixture of 30-35 percent clay, 60-65 percent anhydrite and 5 percent carbon was burned at 1,000-1,400 deg. C. in a standard rotary cement kiln. The resulting product is a mixture of lime, alumina, silica, iron and other metal oxides. This clinker is not a cement. It is ground to usual cement fineness, treated with a sodium carbonate solution and filtered. The optimum carbonate concentration was not determined but pilot operations had worked in the 18 to 30 percent range. The stronger solutions were better technically.

Residual solid, removed by filtration, was a mixture of calcium carbonate, silica, iron and other oxides. If there are not excessive amounts of clay in the original mixture, this precipitate can be reburned to an excellent cement.

Decanted solution carried sodium aluminate and carbon dioxide. By a treatment of the solution, sodium aluminate is broken down to alumina. Al_2O_3 and sodium carbonate, Na_2CO_3. The latter is recovered and returned to the earlier stage of treatment. The alumina or hydrate is settled, filtered and dried prior to calcination in a kiln at 900 to 1,000 deg. C. Finished alumina by this procedure, ready for reduction, was said to be of good quality with silicon less than 0.3 percent, iron less than 0.3 percent and traces of magnesium and calcium.

The latter stages of this procedure resemble the Bayer process.

It was understood that a short demonstration run on a production scale and had shown the process to be workable. Estimates place the cost of alumnia by this process at 125 percent of the cost from imported bauxite. It was stated that the cement plant daily output would be substantially reduced when working on the clay process, i.e., the production of alumina-silica would be less than 500 tons daily.

Digest from "Aluminum From Clay," by J. T. Kemp, A. J. Sidney and H. H. Hall.

Phosphoric Acid vs. Materials of Chemical Plant Construction

Here is Part I of a symposium in which the manufacturers of corrosion resistant materials discuss the suitability of their products for phosphoric acid service. Part II will be published next month. Other chemicals will be dealt with in future symposia.

WORTHITE

W. E. PRATT
Worthington Pump and Machinery Corp.
Harrison, N. J.

TYPE 304 stainless steel is useful with weak cold solutions of H_3PO_4, while types 316 and 317 (casting designation CF-7M) are quite resistant to higher concentrations at elevated temperatures. For concentrated solutions at high temperatures, especially when contaminated with H_2SO_4 and fluorine and its compounds, the high nickel-chrome-moly alloys are more economical. Worthite (24 percent Ni, 20 Cr, 3 Mo, 3.25 Si, Cu, Mn) has been used for many years in all strengths of H_3PO_4, up to 250 deg. F., with and without H_2SO_4 and HF, and carrying high percentages of solids in suspension.

Tests made in the Worthington Laboratories on reagent H_3PO_4—5, 40 and 70 percent at 176 deg. F.—showed no loss. Tests were made in air agitated solutions. A Worthite specimen was exposed in a phosphoric acid evaporator for 217 days in a location where the velocity was high. Acid concentration was 85 percent, temperature 165 deg. F., and corrosion rate 0.0072 ipy. Crude H_3PO_4 containing H_2SO_4 and HF is more corrosive, but Worthite is considered an economical material of construction and is widely used for pumps and valves. Tests were made in a solution containing 3-4 percent H_3PO_4, 3-4 percent H_2SO_4, and 0.05 percent HF. At room temperature the corrosion rate was 0.00103 ipy., and at 176 deg. F., 0.055 ipy.

In one of the southern plants manufacturing H_3PO_4 by the "wet process" Worthite is used for acid concentrations up to 75 percent at 205 deg. F., carrying high percentages of abrasive solids in suspension. Eighteen Worthite pumps and over 60 Worthite valves have been purchased by this one plant.

One of the western plants uses centrifugal pumps for delivering the slurry, or "mud," to the filters. Solids run as high as 65 percent by volume and the temperature ranges from 130 to 140 deg. F. with acid content at 27 percent. Rubber lined pumps gave a maximum life of about two months. Worthite pumps installed about 1¼ years ago are giving excellent service.

In plants manufacturing H_3PO_4 by the electric furnace process, Worthite pumps and valves have been used for concentrations up to 85 percent and up to 250 deg. F. This pure acid apparently has no corrosive effect at all on the Worthite alloy.

Many industries use phosphoric acid in quantities requiring pumps up to 3-in. size. Some of the applications using Worthite pumps are indicated below:

Aircraft Industry—Very weak acid and strong acid up to 1.809 sp.gr.

Brass Industry—85 percent acid, room temperature.

Char Manufacture—50 percent acid plus char as a slurry, high temperature. Stuffing box problem severe where water seal cannot be used. Special mechanical seal solved the problem, gave 13 mo. continuous service before stator element required replacement.

Dairy Industry—Acid used up to 71 percent. Maximum temperature reported 130 deg. F.

Metal Fabricating—Automobile sheet metal fabricated parts are cleaned with Dioxidine (phosphoric acid and alcohol), rust proofing, parkerizing, bonderizing and other phosphoric acid treatments. Worthite pumps are used for circulating and phosphate sludge disposal. Acid is used up to 1.88 sp.gr.

Sirup Clarification—Various sirups, molasses, etc., are clarified by use of phosphoric acid and char, using Worthite pumps for pumping to filter presses. Maximum temperature reported 185 deg. F.

Mushroom Production—Phosphoric acid, amyl acetate and water.

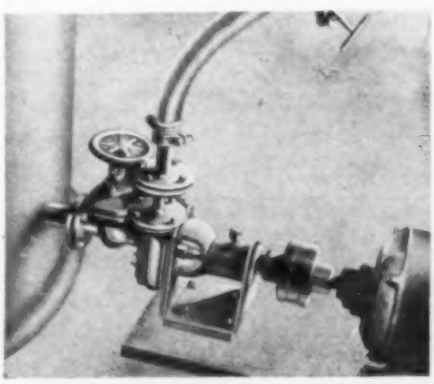
Pharmaceuticals—70 percent acid, room temperature.

Petroleum Industry—85 percent H_3PO_4 plus hydrocarbon oil.

Pigment Industry—H_3PO_4 and gypsum slurry, 1.6 sp.gr.

Phosphoric acid plants have ordered Worthite bars, bolts and nuts, welding electrodes and metallizing wire, and other items—exact uses not stated. Welding rods and metallizing wire are undoubtedly used for building up worn parts. Heat-treatment after welding is required to bring out the full corrosion-resistant properties of the alloy, but fortunately Worthite is so resistant to H_3PO_4 that subsequent heat-treatment is not too important. Since some of the slurries handled are quite abrasive, the repair of worn parts by welding or metallizing may greatly extend the useful life of impellers, shafts and shaft sleeves.

Worthite pump handling monocalcium phosphate containing approximately 30 percent H_3PO_4 at 127 deg. F.



ILLIUM "G"

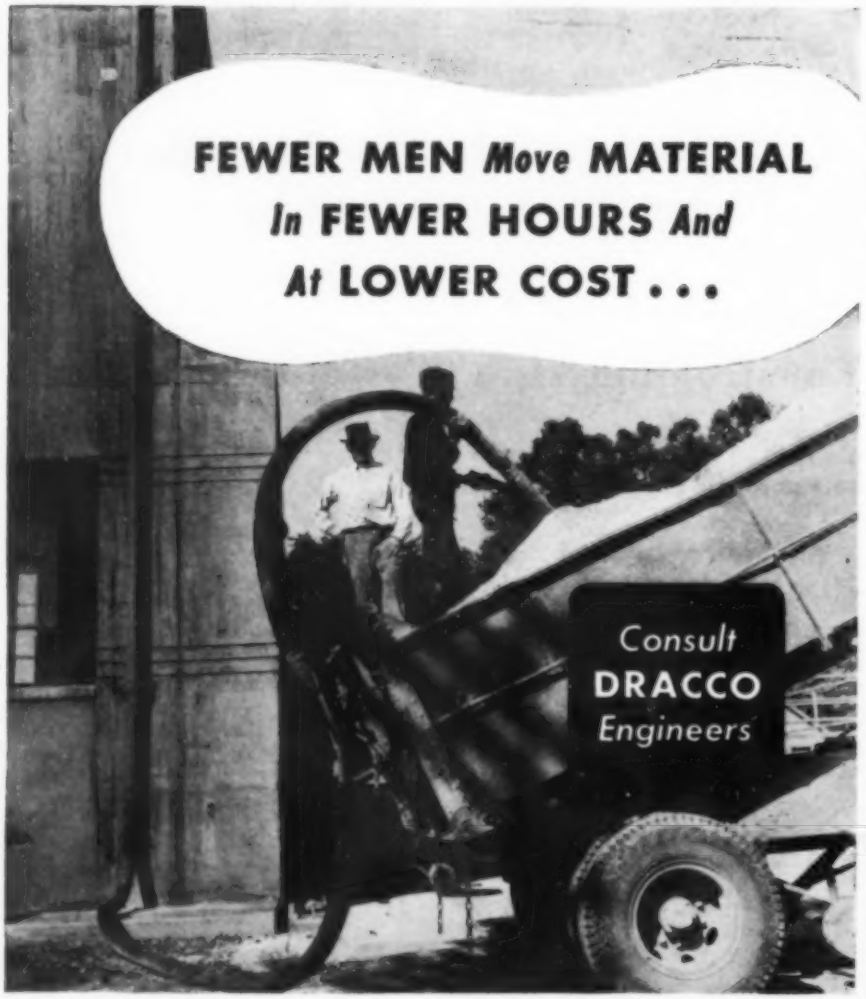
T. E. JOHNSON
Burgess-Parr Co.
Freeport, Ill.

ONE OF THE pioneer machineable corrosion resistant alloys, Illium "G," is used extensively by industry in combating the corrosion of sulphuric, nitric, and mixed acids and is finding an increasing use in phosphoric acid applications.

The alloy was designed to resist that most difficult range of acid corrosion in which both acidic and oxidizing environments are encountered. Both the pure and technical grades of phosphoric acids are resisted by the alloy and, as a general rule, corrosion data show that the penetration rates of the alloy in technical acid are slightly higher than in the pure acid. This is due to the oxidizing action of the impurities usually present in the technical acid. It should be noted that minute variations in the quantity or type of impurities present in the technical grade acid can greatly change the penetration rates of the alloy. While published penetration data for the pure acid can generally be used as a guide in selection, specific tests are recommended when the technical grade acid or acid salt solutions are to be handled.

The Freeport laboratories of the Burgess-Parr Co. recently made a detailed study of the performance of Illium "G" in resisting the corrosion of various commercially pure phosphoric acid solutions. The results of this study are listed in the following table.

All tests were made in laboratory glass-



The DRACCO System shown above unloads eleven tons in an hour and thirty minutes and conveys the material to the third floor. Many such installations, handling chemicals, grains and granular materials, are saving hours, manpower and dollars every day. A DRACCO Pneumatic Conveyor and ONE man often replaces SEVERAL men, and will do a much better job than is possible with obsolete handling methods. Why not let DRACCO Engineers check your present material handling methods for you? They have more than 30 years' experience in reducing the cost of handling many materials.

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DRACCO CORPORATION

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ware using approximately 500 ml. solution per sample. The solutions were made up using commercially pure acids and were not circulated or replaced. Each test specimen used was cast from a different production heat of the alloy and it is believed that the data listed are a reliable indication of the performance that can be expected when using the alloy under similar operating conditions.

Corrosion Rates of Illium "G" in Commercially Pure Phosphoric Acid

Acid Concentration, Percent by Wt.	Temperature, Deg. C. 22	88	Boiling
	Mils Penetration Per Year		
10	<0.168	<1.68	<1.68
30	<0.168	<1.68	<8.4
50	<0.168	<1.68	69.5
85	<0.168	<1.68	271

The results reported in the preceding table are average values of tests made on numerous samples exposed to the specified acid concentration and temperature. No attempt was made to aerate the solutions and it may be assumed that where corrosion was encountered, the initial free oxygen was rapidly removed from solution. Aeration will tend to make the pure acid less corrosive to Illium "G."

Illium "G" is available in casting form and is readily machineable and weldable. It is being used at present in pumps handling phosphoric acid solutions; shaftings, bearings, and impellers for mixing and agitating equipment; liquid metering parts; and in a wide variety of miscellaneous applications in the special machinery field.

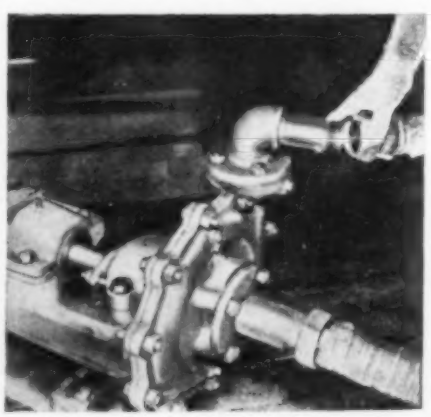
HASTELLOY ALLOYS

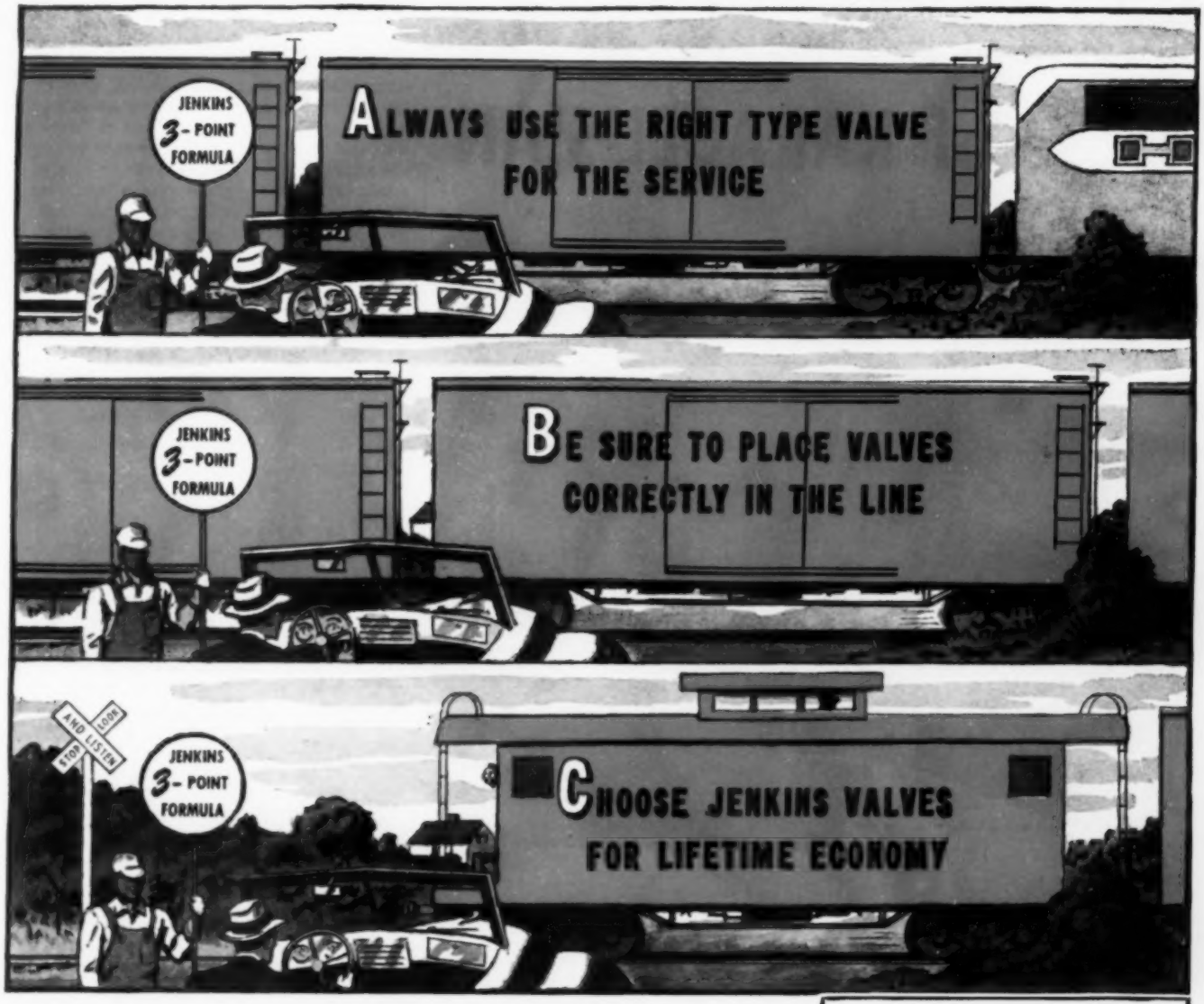
C. G. CHISHOLM
Haynes Stellite Co.
Kokomo, Ind.

THE HASTELLOY alloys, a series of high-strength nickel-base corrosion-resistant alloys designated as grades A, B, C, and D, have excellent corrosion-resistant properties for phosphoric acid. The general rate of attack on these alloys at normal room temperature is higher in the weaker acids, with the corrosion rate falling off rapidly as the strength of the acid increases. In 85 percent phosphoric acid at room temperature there is practically no measurable rate of penetration. In chemically pure phosphoric acid at room temperatures, the highest rate of attack on any grade is only 0.002 ipy.

With increase in temperature, the cor-

All-Hastelloy pump and fittings handling dilute H_3PO_4 solutions

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STOP LOOK AND LISTEN
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There's no getting around the logic of this proved 3-Point Formula for trouble-free, time-defying hookups.

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JENKINS Fig. 92
Regrinding
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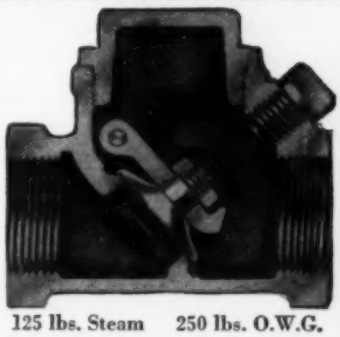

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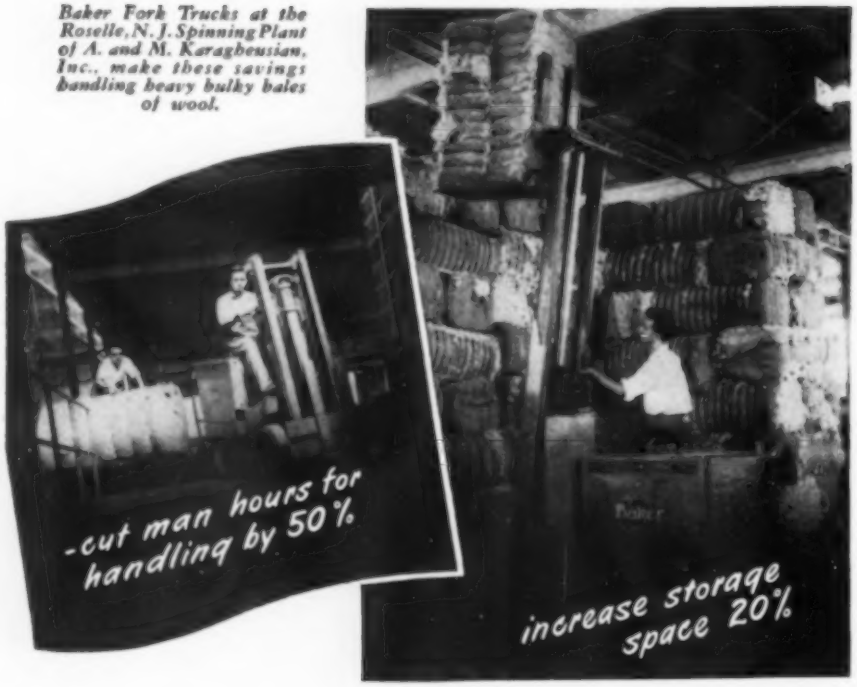
Baker Trucks at the House of KARAGEUSIAN

Baker Fork Trucks at the Roselle, N. J. Spinning Plant of A. and M. Karagheusian, Inc., make these savings handling heavy bulky bales of wool.



This company is one of the world's largest manufacturers and importers of Chinese and Persian carpets, as well as a leading manufacturer of domestic rugs. Bales of wool, weighing from 350 to 1200 lbs. are received in carload lots from all parts of the world. The Baker Fork Trucks unload these bales and transport them to storage and processing departments—saving up to 50% in man-power hours over former methods. One of the trucks stacks bales for storage to a height of over 200 inches, enabling the company to use up to 20% more warehouse space.

At the Roselle plant, the wool is processed by washing, scouring, dyeing, and spinning into yarn. It is then shipped to other plants where it is woven into the nationally known "Gulistan" rugs for which the House of Karagheusian is famous.

Our files contain many case histories of Baker Trucks making similar savings in all types of plant and warehouse operations. A Baker Material Handling Engineer will gladly show you how they may be applied to your problem.

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Baker INDUSTRIAL TRUCKS

rosion rates accelerate on hastelloy alloys A, C, and D, particularly as the strength of the acid increases. Hastelloy B however has a relatively low rate of attack in all concentrations. Unlike grades A, C, and D, alloy B has a somewhat lower corrosion rate in boiling 85 percent acid than it has in the weaker acids. In 85 percent boiling chemically pure phosphoric acid the rate of attack of 0.00156 in. per year is the same as that encountered in 10 percent chemically pure acid at room temperature. The table below shows the corrosion trend on the four alloys, in concentrations ranging from 10 to 85 percent at the boiling point and at room temperatures.

Corrosion Rates of Hastelloy Alloys in Pure Phosphoric Acid

Acid Concentration, %	Hastelloy Alloy Designation A	B	C	D
	Mils Penetration Per Year			
Room Temperature:				
10	2.16	1.56	0.0804	1.44
30	1.32	0.888	0.0384	0.528
50	0.876	0.708	.....	0.396
85	0.300	0.180	0.0768	0.264
Boiling Temperature:				
10	26.4	1.80	1.44	2.76
30	21.6	2.40	5.04	5.28
50	32.4	1.68	3.00	49.2
85	816	1.56	484	324

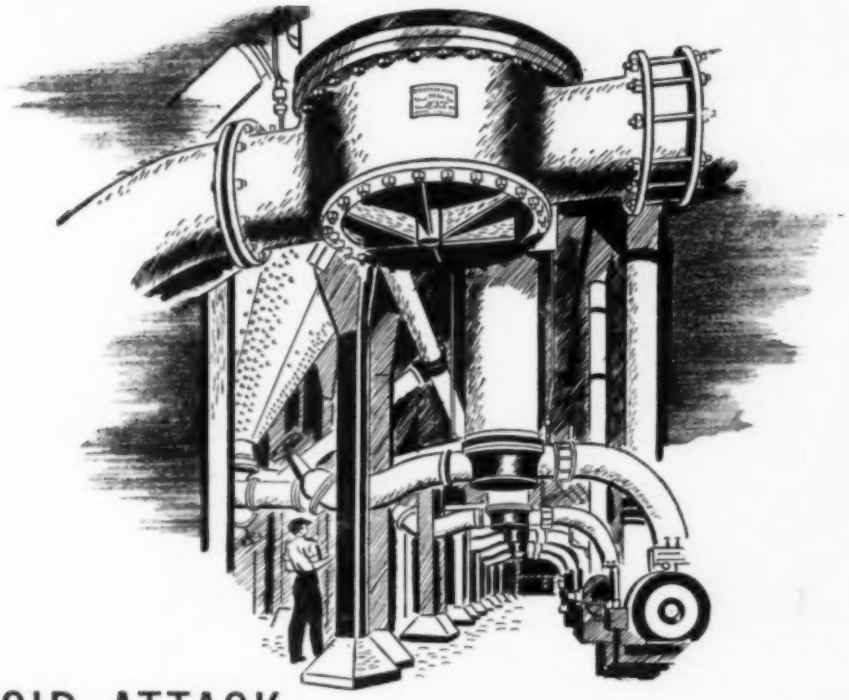
The table on corrosion rates shown above is based on laboratory conditions with chemically pure phosphoric acid and cannot be construed to be indicative of corrosion rates in the field, as crude phosphoric acid contains many impurities which would tend to increase the corrosion rate, or in some cases, possibly slightly lower it. Crude acid produced from rock from different locations will have varying amounts of fluorine and sulphur trioxide that tend to affect the corrosion rate. The table below indicates the effect of corrosion by crude phosphoric acid on Hastelloy alloys.

Corrosion Rates of Hastelloy Alloys in Crude Phosphoric Acid

Acid Concentration, %	Hastelloy Alloy Designation A	C	D
	Mils Penetration Per Year		
Tested at temperature of 79–81 deg. C.:			
50	40	3	17
25	88	7	31
10	114	8	51
Cd*	710	15	2
Ce*	331	10	81

* Cd = Crude dilute, Ce = Crude concentrated. Based on tests run by P. R. Costing and Conrad Hines, Jr., Bureau of Chemistry and Soils, Washington, D. C.

At the time these tests were run, Hastelloy B was unfortunately not included because of its lack of oxidation resistance. It is quite probable, however, that in crude acid, accelerated corrosion rates in grade B would be comparable to those encountered on grade A. All of these tests were run in acids produced from Tennessee brown rock in aerated solutions, with the exception of the test in crude concentrated acid. In this test, there was no aeration. In general, dilute crude acid is more corrosive than the concentrated crude acid, as the fluorine and sulphur trioxide content is higher in the more dilute acid. Because the effects of impurities on the rate of attack are so critical, a laboratory test should be taken only as a guide to the proper material of construction for handling phosphoric acid. Tests should be run wherever possible under plant operating conditions with acid from a



RESISTS ACID ATTACK

Stainless Steel Means Longer Life for Processing Equipment

This equipment is used in a process which involves the continual circulation of a corrosive sulphite liquor. Paper mill men say the process would not be possible without the use of stainless steel for pipes, valves, and fittings. These installations have thoroughly demonstrated the effective resistance of the metal to the corrosion encountered in the industry. Stainless steel is also extensively used in the chemical and petroleum industries, where again corrosion is the enemy of low maintenance costs and uninterrupted production.

If you are interested in other new uses of stainless and other alloy steels, ask to receive the monthly publication, ELECTROMET REVIEW. If you need information on the production, properties, or fabrication of these steels, write our Technical Service Department. While we do not make steel, we do produce the ferro-alloys which are used in its manufacture, and our engineers have accumulated a fund of information on the use of stainless steel in many industries.

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source which will be used for production lots of acid.

Tests under various conditions throughout the TVA plant were run on all available corrosion-resistant materials in contact with phosphoric acid in the various stages of manufacture. Here again Hastelloy alloys A, C, and D were more resistant to crude phosphoric acid than all the other samples tested and showed a wider range of satisfactory corrosion resistance under all plant conditions. It is sometimes more economical to use brass, high-silicon iron, or stainless steel where corrosion rates indicate that a useful life of equipment can be obtained. However, when strength of materials in combination with corrosion resistant properties is required for critical parts, the Hastelloy alloys can be economically used in spite of their higher initial cost. When freedom from impurities that result from the corrosion product is important, the use of the Hastelloy alloys may be essential. In some cases a useful life might be obtained from equipment fabricated from a material with lower first cost, but the corrosion product would be too great for requirements of the process.

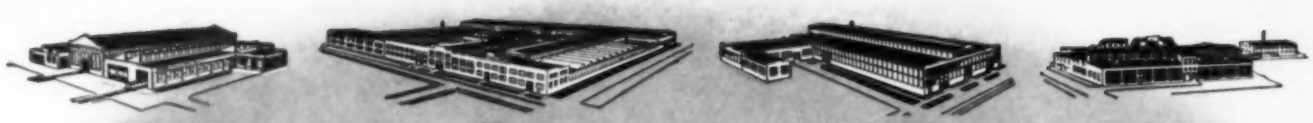
A large dye manufacturer has used Hastelloy alloys B and C successfully where it must resist phosphoric acid for agitating equipment, blowpipes, and heating coils in glass-lined vessels where it is particularly desirable to avoid contamination in the finished product. Much of this equipment has been in operation successfully for approximately six years. Many of the large phosphate plants are employing Hastelloy alloy B successfully in the form of agitators, mixing paddles, thermometer wells, piping, pumps, and valves. Hastelloy alloy B is generally the most resistant to phosphoric acid, with alloy C next. Since both grades are available in the form of castings, hot rolled sheet, plate bar stock, welding rod, welded tubing and drawn wire, they can be used successfully as materials of construction for practically any type of equipment required to process phosphoric acid.

GLASS-LINED STEEL

O. I. CHORMANN
The Pfaudler Co.
Rochester, N. Y.

THE QUESTION frequently arises regarding the chemical durability of glasses, as applied to steel equipment, towards the action of various concentrations of phosphoric acid, at room and elevated temperatures. The present day status of the corrosion resisting property of glasses for handling phosphoric acid may be briefly stated as follows:

1. Glass lined steel equipment should not be considered for handling phosphoric acid containing even traces of soluble fluorides, either at room or elevated temperatures, due to the fact that the impure acid will attack the glass, resulting in marked disintegration of the glass lining. The rate of attack is accelerated as the temperature increases.
2. Glass lined steel equipment may be successfully used for handling phosphoric acid, free from soluble fluorides, at temperatures not greatly in excess of room temperature.
3. Glass lined steel equipment is not recommended for handling high concentrations of phosphoric acid, free from soluble

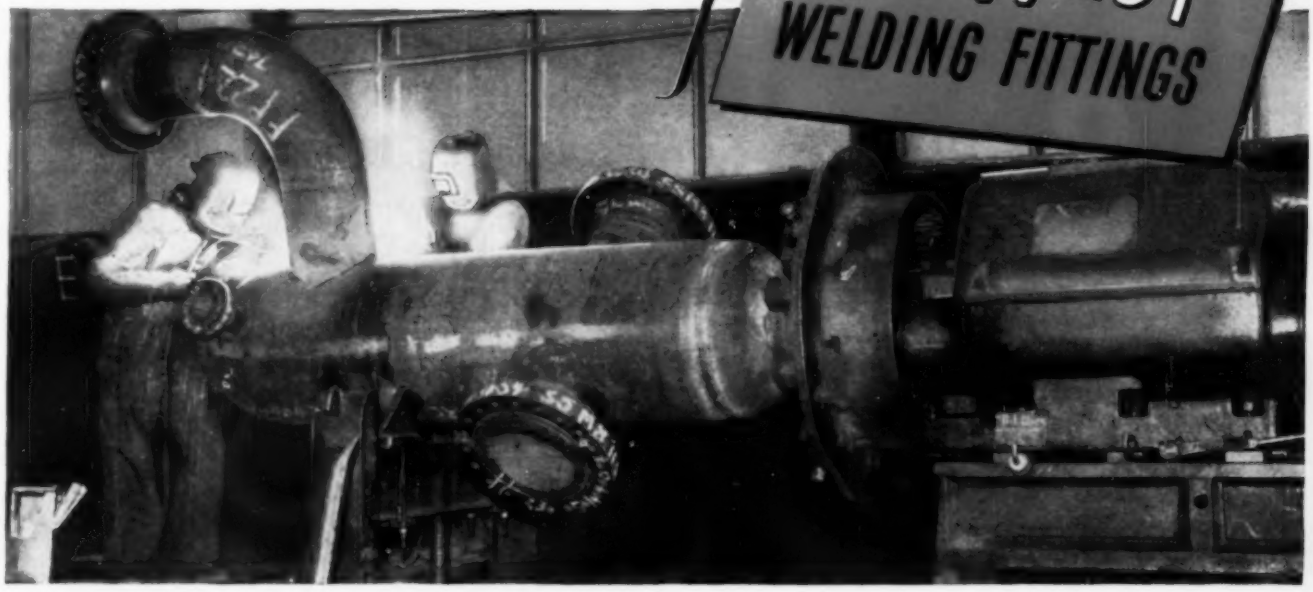


AT LOS ANGELES AT ST LOUIS AT PASSAIC AT SOUTH BOSTON

MIDWEST PIPE FABRICATING PLANTS

Make a *CONTINUOUS CHECK*

on the HIGH QUALITY of MIDWEST WELDING FITTINGS



Four modern Midwest pipe fabricating plants supply piping for all purposes and pressures to a great variety of industries from coast to coast. These Midwest plants are large users of Midwest Welding Fittings. This regular everyday use of these fittings in fabricating both simple and complex piping subassemblies provides an accurate and continuous check of their quality . . . of correct dimensions . . . of uniformity . . . of accurate angularity, etc.

But this daily use in our own fabricating plants does more than check quality . . . it makes certain that Midwest Fittings are thoroughly practical . . . that they meet the needs of modern piping practices from a design standpoint . . . that they are easy to lay out and weld. For example: the accuracy of Midwest machining methods makes it possible for the user to cut his pipe before receiving his Midwest Welding Fittings . . . he can depend upon the catalog dimensions. Buyers of Midwest Welding Fittings get the benefit of this unique situation. We sell you the same fittings we use . . . assuring you of quality fittings that are correctly designed and that save time and money on many different kinds of piping jobs. Bulletin WF-41 gives all the facts; ask for a copy.

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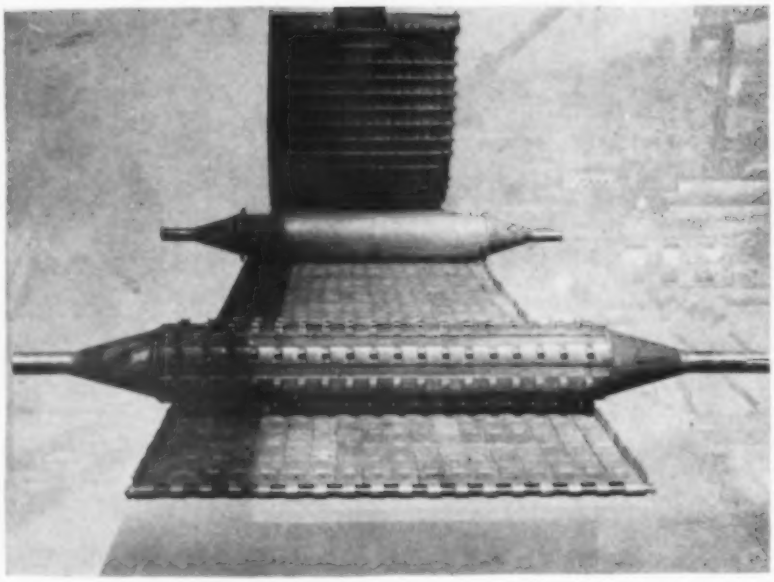

It's a conveyor assembly for a heat-treating furnace, alloyed and cast for a large manufacturer of automobile parts. Perhaps you would be interested in some facts:

Alloying Elements . . 15% Chromium, 35% Nickel
Conveyor Belt . . . . 8,400 pounds, statically cast
Head Shaft . . . . . 1,625 pounds, centrifugally cast
Tail Shaft . . . . . 804 pounds, centrifugally cast

The belt consists of several thousand individual links assembled and held together by alloy steel rods. No machining of the links was necessary. The lugs on the head shaft were cast integrally with the shaft. The end cones on both shafts were cast statically and then welded on.

You may not need a conveyor for a heat-treating furnace such as this, but if you need *any* high alloy casting—for resisting heat, corrosion or abrasion—we would like to discuss producing it for you. Our experience in static castings goes back to 1922 and in centrifugal castings back to 1931, both pioneering dates.

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fluorides, at elevated temperatures, due to a gradual disintegration of the glass, with the result that the service life of the equipment may be unsatisfactory.

In cases where glass lined steel equipment is being used, involving fluoride-free phosphoric acid at elevated temperature, the user is fully advised of the attack on the glass and the resulting decrease in service life of the equipment. In some cases the life of the glass lining has been satisfactory.

In order to obtain more definite information upon the subject, tests were conducted at room temperature for a period of six months—no agitation nor aeration. Another series of tests were conducted at the boiling points of various concentrations of phosphoric acid for a period of 30 days. In all tests, c.p. phosphoric acid, free from soluble fluorides, was used.

The results obtained, expressed in "mils penetration per year," are given in the following table. The values for the tests at boiling temperature show a far greater action than the corresponding tests at room temperature.

Corrosion Rate of Standard Pfaudler Glasses in Pure Phosphoric Acid

Acid Concentration, % by Wt.	Number of Glass 42	42PF	24
	Mils Penetration Per Year		
Room Temperature Tests:			
2	0.00591	0.00787	0.00566
5	0.00839	0.00549	0.00586
10	0.00791	0.00762	0.00394
20	0.0173	0.0116	0.00961
40	0.0186	0.0154	0.0138
60	0.0195	0.0148	0.0118
85	0.0136	0.00573	0.00560
Boiling Temperature Tests:			
5	0.329	0.866	.....
20	0.783	1.058	.....
40	1.367	1.572	.....
85	16.19	27.7	.....

Assuming an average thickness of the highly acid resisting glass to be 36 mils, then the probable calculated life of the glass lining, *based solely upon its chemical durability*, for the highest values obtained, is as follows:

Acid Concentration, Percent by Wt.	Temperature	Glass No.	Est. Life, Years
40	Room	42PF	2,340
40	Room	24	2,600
40	Boil.	42	26.3
40	Boil.	42PF	22.9
60	Room	42	1,850
85	Boil.	42	2.2
85	Boil.	42PF	1.3

For glass No. 24 use same values as for glass No. 42, at boiling temperature

It should be emphasized that the foregoing life expectancies must not be construed as representing the probable life service of glass lined steel equipment under actual operating conditions, because necessarily they do not evaluate uncontrollable variables such as areas of sub-average thickness, abrasion, imperfections in the steel shell or the glass or mechanical injury.

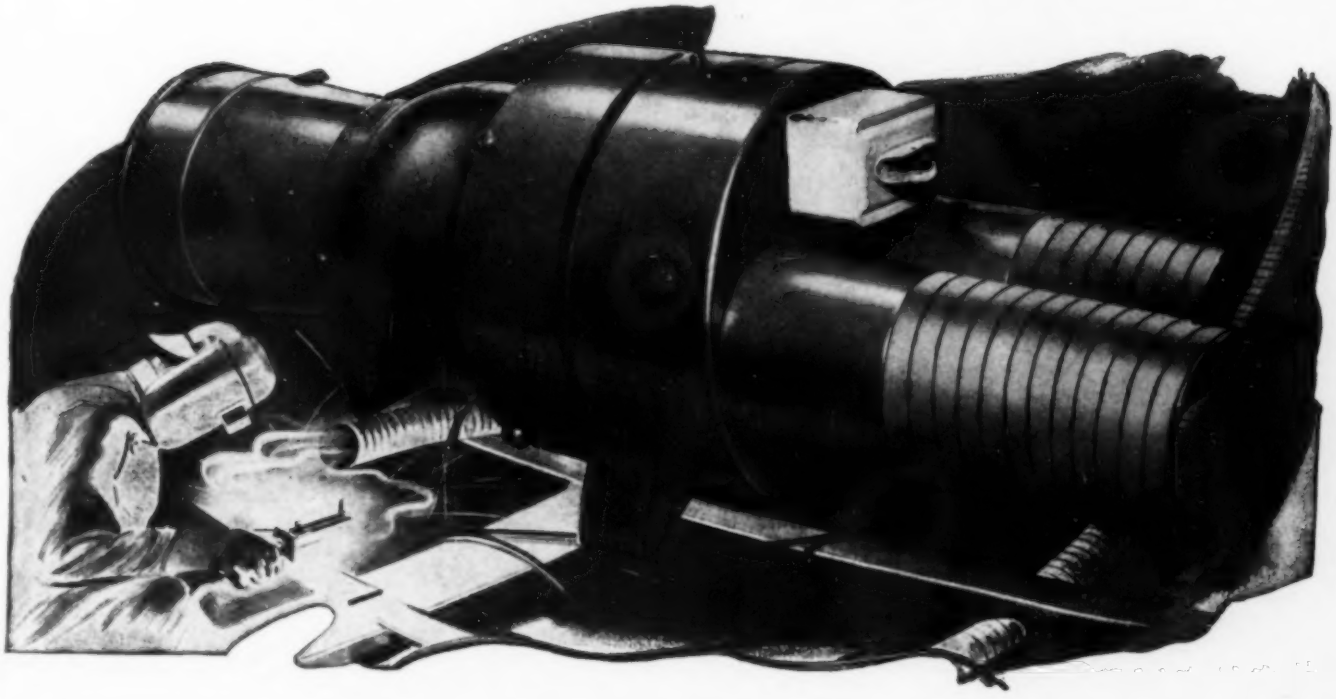
The estimated life for all concentrations of phosphoric acid, free from soluble fluorides, reveals that the chemical durability of the respective glasses listed is satisfactory providing the temperature is at or near room temperature.

For conditions involving elevated temperatures, glasses No. 42 and No. 42PF, and No. 24, are satisfactory for all concentrations of phosphoric acid up to but not exceeding 40 percent by weight.

For concentrations of phosphoric acid in

An Extra Lung for A Man

HAVING TROUBLE BREATHING



The amount of work a man can do goes *down* when foul air comes *in* or the heat goes *up*. Are you giving your workers the equipment that will keep them efficient even when working in hot or noxious fumes?

Many concerns regard Coppus Blowers as "production tools" as well as "safety equipment". They help men to do more work and better work.

You can find in the Coppus line the right blower or exhauster for each "bad spot"—or perhaps one type will handle a variety of jobs. In addition to man-cooling and removing fumes from confined places, Coppus Blowers are used for cooling and drying materials and equipment. They are portable . . . efficient . . . built to Coppus "Blue Ribbon" standards of construction and workmanship in order to withstand severe usage.

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- ☐ on steam-heated rubber processes.
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excess of 40 percent, and involving elevated temperatures, considerable thought should be given to the advisability of using glass lined steel equipment, owing to a probable short service life of from one to two years.

WOOD TANKS

S. E. CHANEY
National Wood Tank Institute
Chicago, Ill.

FOR MANY years wood tanks have been used in phosphoric acid service. In some plants materials have been used as a lining where experience has indicated the acid is detrimental to the specific species of wood used in the manufacture of the tank.

Where use of wood tanks in phosphoric acid service is concerned it must be recognized that phosphoric acid affects are intermediate between non-corrosive organic acids and the mineral non-oxidizing acids, such as hydrochloric and sulphuric acids. Phosphoric acid of a given strength hydrolyzes wood more slowly than sulphuric acid of the same strength. A longer life should therefore be expected from a wood tank used to contain phosphoric acid than for a wood tank used to contain sulphuric acid of the same concentration.

There is considerable difference of opinion with respect to the most suitable wood for acid work. Some species have given excellent results in a wide variety of applications of the inorganic acids. Aside from the consideration of oxidizing affect the pH value of any inorganic acid offers an index of the action on wood of any acid.

Phosphoric acids are relatively weak, and at normal temperatures have no important disintegrating affect on some woods.

Wood is satisfactory for 10 percent acids. Over 10 percent strength, a lining has been deemed necessary. A strong acid acts destructively and a lining of some material is used. Wood tanks have in some instances been in service for 17 years and longer. Concerning the 17-yr. installation, these particular tanks are of various capacity, 18 ft. dia., and up to 12 and 14 ft. high. Three inch fir was the wood used, and the lining was lead and/or chemical brick. They have not been under pressure, but have closed tops. They handle 50 to 75 percent acid at 75 deg. C.

Rectangular wood tanks are commonly used in phosphoric acid service. In the transfer of solutions, wood troughs or launders have an advantage over metals in that wood does not plug and close by scaling. Fume ducts and stacks in phosphoric acid service may be of wood if it is paraffin treated. In a large chemical plant in the South wood thickeners of the Dorr type have been in use for years and are giving satisfactory service.

Many manufacturers whose product is from low grade rock using sulphuric acid use tanks and filter presses made of wood. Filter plates are pitch pine; frames are pine or oak, and in one instance the launders or gutters are made of plum tree wood. Redwood has also been used successfully in phosphoric acid service.

Wood tanks are used in the manufacture of fertilizer phosphates, phosphate water softeners, baking powder, beverages, and other food products.

FROM THE LOG OF EXPERIENCE

DAN GUTLEBEN Engineer

CARBON DIOXIDE exudes from fermenting mash at a purity of around 99.8 percent. Within this small departure from perfection there lurks an obnoxious odor. A beet sugar company in Anaheim, Calif., built a distillery in 1921 and, following inexpert advice, installed a lye absorption system for the purification of the CO_2. The lye had no prejudice against the odor in the fermenter gas and so the gas with its incorporated aroma passed through to the customers' containers. Doc had pioneered in the purification of fermenter gas and the manufacture of both liquid CO_2 and dry ice and in fact held basic patents. His repute attracted him to the distressed owners and he was commissioned to manage the distillery and reconstruct the CO_2 plant. Soon his reconstructed plant got into production and the product was haled for its ethereal qualities (see *Chem. & Met.*, Feb. 2, 1945). The resistance to change frequently presents a humorous spectacle. The original aromatic CO_2 had brought the producers ill fame. The local CO_2-producing monopolist made capital of this. He had been in the field a long time and resented intrusion. The profit had been all the traffic would bear. When Doc's product improved technically and editorially, the "octopus" plastered stickers on its cylinders "Guaranteeing the CO_2 in this tank to be of highest purity, free of butyl and sulphurous compounds, aldehydes, air and moisture. A manufactured product—not a by-product."

Doc countered with "Natural carbonic gas; exclusively a home product; pure CO_2; not made from coke or minerals." It was as if the hydroelectric company would announce "clean white electricity, not made from dirty coal or oil." The competitor cut prices and Doc met them. When the coke gas reached its limit Doc still had a small margin left. Then the competitor capitulated, suggested a round table conference and thereafter submitted to sportsmanship in his sales policy.

HABIT HAS A PRICE, as has anything else that is worth having. In the good old days of 1912 the customer for blackstrap molasses demanded a density of 80 Brix—no more, no less. The run-off from the centrifugals registered 85. The pump could not handle this heavy material and so the ingenious polander reduced the density to about 75 by injecting hot water into the pump suction and delivering the molasses to the pan floor, four stories up, where it was concentrated to exactly 80 Brix. The mentality and the mechanism for proper proportioning did not exist on the fourth floor and so the sugar boiler accepted the additional task of wasting steam as a temporary expedient. By the time a pump of robust design was installed the habit had become fixed. For years the molasses was diluted on the fourth floor, concentrated on the seventh, discharged thence to the first floor of the new distillery, and there diluted to 17 Brix for fermentation. When the Old Man discovered it, the practice was discontinued. The discovery was followed by the evolution of great din and profanity and certain painful gratuitous expressions of opinion!

HOKUS POKUS substitutes for chemistry in devious ways. Doc submitted to the engineering department a sketch for a silver lined laboratory autoclave, 3-in. dia. to withstand a working pressure of 1,000 lbs. He had started with a modest requirement of 1-in. dia. and 300 lbs. pressure and included this at $225 under an appropriation for research supplies. He mentioned the trifle to the Boss and remarked that in view of urgency he would prefer to have our maintenance shop build it. Quoth the Boss, "Sure, tell Dan to make it right away." The shop, not subject to overhead or manufacturing profit, built the autoclave with the silver lining and some silver cocks at a cost of about $500. Doc accepted it with thanks. His clerk exhibited a proposal by an outside shop of $1,000.

INTRAMURALLY, the activities are of lesser spiritual uplift but exciting nevertheless; "Pumps" Dan Hanneberry sensed a certain palling monotony. He craved hilarity. Accordingly, he launched an innocent rumor to the effect that the *Inquirer* (Rep.) carried an advertisement offering to close out a stock of powerful prewar whiskey at 50 cents per quart. Sam Perovich, erstwhile mayor ("honoris causa") of Chesselhurst, now melter-house foreman, was the first to pick it up. Forthwith he instituted diligent search but could find nary an *Inquirer*. Dan and Frank Harvey are the only pan house attaches who read the *Inquirer*, the balance of the hewers of wood, being of Democratic Faith, read the *Record*. Finally, however, Sam stole into Frank's office and searched the *Inquirer* from cover to cover. Then he left the office a dejected man. Others picked up the "vine" and sent out for *Inquirers*. Finally Dan himself furtively combed the advertising section and satisfied himself that the rumor was groundless!

YOUTHFUL APTITUDES are of course determined by the application of psychiatrical analysis. There was a time, however, when a lad was urged and almost duty bound to follow the profession of his father. Thus the chronicler was earmarked for the ministry against his natural inclinations. Around '95, Dr. Raymond, president of Union College in New York came to Nebraska and discoursed at "Convocation" on the subject of job selection. He propounded that a well defined inclination indicated the line that God intended the boy to follow. When this proposition was submitted to good old dad, he twinkled "Well, but Dr. Raymond is a Presbyterian."

DOC'S Ph.D. was acquired in Austria. He migrated to Buffalo some years before War I. After a time he indulged in the great American "Freedoms" and got a job in a distillery in Canada. When Canada joined England in the War, the boys north of the border felt jittery about harboring undeclared visitors and so a sentry was assigned to the block where Doc lived. One night Doc decamped, leaving the light in his room and caught the express for Niagara. The first passenger that he met was an old chess-playing companion in the uniform of a U. S. revenue officer, and of course the old obsession got promptly under way. Directly the Canadian immigration officer observed the absorption in the game and courteously refrained from interruption.

SUGAR POSSESSES the extraordinary quality of refusing to crystalize in the presence of impurities. Every twenty years the statistical consumer consumes one ton of sugar which he buys from the corner grocer (and not from the apothecary who was once the distributor). During the twenty year period the consumer of the sugar eats three ounces of harmless impurities for which he was gypped one cent.

THE PATCHES on Sandy's blue work shirt above the belt line are supplied from the tail, which under ordinary circumstances is not exposed to public view. However his natural thrift is publicized in Mrs. Sandy's washline. The bottom fringe of the shirt is a varicolored crazy quilt.

CAPTAIN JIMMIE, chief engineer of a large New Jersey cranberry processing plant, just released from the Air Corp, took in the Chemical Show with our Doc. Jimmie was wearing a sombrero of the Texas cowboy style. During his training in Texas, he had become intrigued by the broad brim and the swashbuckling wearers and he determined to employ the same means of properly proclaiming his character just as soon as the military lid was off. The hat-check girl practiced her stock in trade of attractiveness and affability which needled Jimmie to enlarge on his experience on the boundless Texas range. At the end of day Jimmie returned to retrieve his hat, contributing a generous gratuity as befits a big hearted cowboy from Texas. The digger returned his salute with "good by New Jersey Cowboy!" Jimmie was inclined to blame Doc but Doc had an albi. He pointed to the New Jersey hatter's stamp under the dome of the hat.

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NAMES IN THE NEWS

Walker Penfield

S. M. Cadwell

Linus Pauling

Walker Penfield has been appointed manager of manufacturing of the Pennsylvania Salt Manufacturing Co. Mr. Penfield was formerly works manager, a position discontinued in a reorganization. **Claude S. Beldin,** regional superintendent has been appointed to the newly created position of production manager, and **Henry G. Meyer,** formerly assistant to the works manager is now assistant to the production manager.

Rubert J. Lindquist, financial vice president of Standard Oil Co. (Ind.), was elected a director last month following the resignation of **Edward G. Seubert** who retired from business after nearly 54 years with the company.

William E. Wickenden, president of Case School of Applied Science, Cleveland, since 1929, has announced that he will retire Aug. 31, 1947.

Harry K. Collins has been appointed manager of the Resin and Insulation Materials Division of the General Electric Co., Pittsfield, Mass. The position was formerly held by the late **Edgar L. Feininger** who was also assistant general manager of the chemical department. Mr. Collins was previously manufacturing manager of the division in Schenectady.

Herbert L. Sherman, treasurer of the consulting firm of Skinner & Sherman, Boston, has been elected chairman of the newly formed New England District of the American Society for Testing Materials.

A. S. Gregory, new research chemist for the Development Department of Weyerhaeuser Timber Co., Longview, Wash., was formerly with the Chemical Warfare Service.

R. C. Thielke, formerly with the research department of Turco Products, Inc., Los Angeles, Calif., has become associate professor in organic chemistry at the University of Idaho, Moscow.

Sidney M. Cadwell has been appointed director of research and technical development of the United States Rubber Co. Dr. Cadwell was formerly assistant general manager of the company's tire division.

Carl E. Barnes, formerly of General Aniline & Film Corp.'s Central Research Laboratory in Easton, Pa., has been named director of product and process development at Ansco. The department headed by Dr. Barnes includes the Color Products Development Laboratory, the Emulsion Development Laboratory, and the Casting Development Laboratory.

R. D. Perry has been appointed to the newly created position of general superintendent of the Research and Development Division of the Consolidated Mining and Smelting Co. of Canada, Ltd.

Charles A. Kraus, professor of chemistry and director of chemical research at Brown University, retired on June 30. He has been appointed professor of chemistry, emeritus.

D. S. Davis, formerly mathematician for the Wyandotte Chemicals Corp., is now in charge of the Editorial Division of the Government Laboratories, managed by the University of Akron, agent for Reconstruction Finance Corp., Office of Rubber Reserve.

Frederick F. House has joined the firm of Jacob House & Sons as a chemical engineer. Mr. House was previously associated with E. B. Badger & Sons Co. of Boston.

Harry L. Derby has retired from the American Cyanamid companies. He was president and director of American Cyanamid & Chemical Corp. of Jefferson Chemical Co., of Arizona Chemical Co., He was vice president and director of American Cyanamid Co., of Southern Alkali Corp., of Southern Minerals Corp., and Southern Pipelines Corp. He also was chairman of Berbice Co. Limited, British Guiana.

Linus Pauling, director of the Gates and Crellin Laboratories of Chemistry at the California Institute of Technology, has been awarded the Willard Gibbs Medal of the Chicago Section of the American Chemical Society. The 1946 Medal went to Dr. Pauling June 14 in recognition of his research achievements not only in chemistry but also in physics and biology.

W. L. Badger has just returned from a trip to Barranquilla and Bogota, Colombia, where he went as adviser to the Colombian Government on its salt plants.

Andrew M. Kennedy has established an industrial consulting service with offices in the Jenkins Arcade Building, Pittsburgh.

James R. Cudworth has been appointed dean of the College of Engineering of the University of Alabama.

Frank W. Jessen has joined the staff of Associated Engineers, Houston, as a consulting chemical engineer.

G. G. Eldredge is now associated with the Shell Development Co., Emeryville, Calif.

Ralph Bown, assistant director of research at Bell Telephone Laboratories since 1944 has been named director of research. Dr. Bown succeeds **M. J. Kelly** who has been serving both as director of research and executive vice president of the laboratories and who will continue in the latter capacity.

Frederick H. Weismuller, who has been director of sales for the Pigments Department of the Du Pont Co. since 1944, has been appointed assistant general manager of the department succeeding **Crawford H. Greenewalt,** who was recently made a vice president and member of the executive committee.

Bertram J. Cross has been designated to take over management of the Development and

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M. A. Hamrick **E. R. Hall** **R. C. Wickersham**

Appointment of three vice presidents of Koppers Co., Inc., has been announced. M. A. Hamrick is vice president of the company's wood preserving division; Edward R. Hall is vice president and works manager at a Baltimore plant of the company; and R. C. Wickersham is vice president of the tar and chemical division

Research Department of Combustion Engineering Co., succeeding the late **Henry Kreisinger.**

Glenn T. Seaborg has returned to the University of California, Berkeley, where he will take charge of the university's research program in atomic chemistry. Dr. Seaborg has been on leave of absence since 1942 to the University of Chicago's Metallurgical Laboratory, where he was in charge of developing a separation process for plutonium.

Richard K. Rettig and E. Lawrence Mongan, Jr., chemical engineering graduates of the University of Cincinnati, and until recently naval officers on Pacific duty, have joined the chemical department of the DuBois Company, Cincinnati. They will work on product applications and process control.

Max F. Moyer, a colonel in the Army Air Forces during World War II, has returned to the Goodyear Tire & Rubber Co. as assistant manager of the Flooring and Builders Supply Department of the Chemical Products Division.

W. H. Tonn, Jr., has been named associate professor of chemical engineering at the

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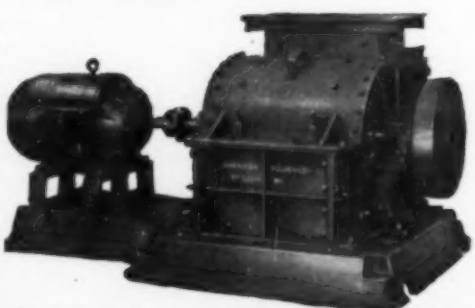

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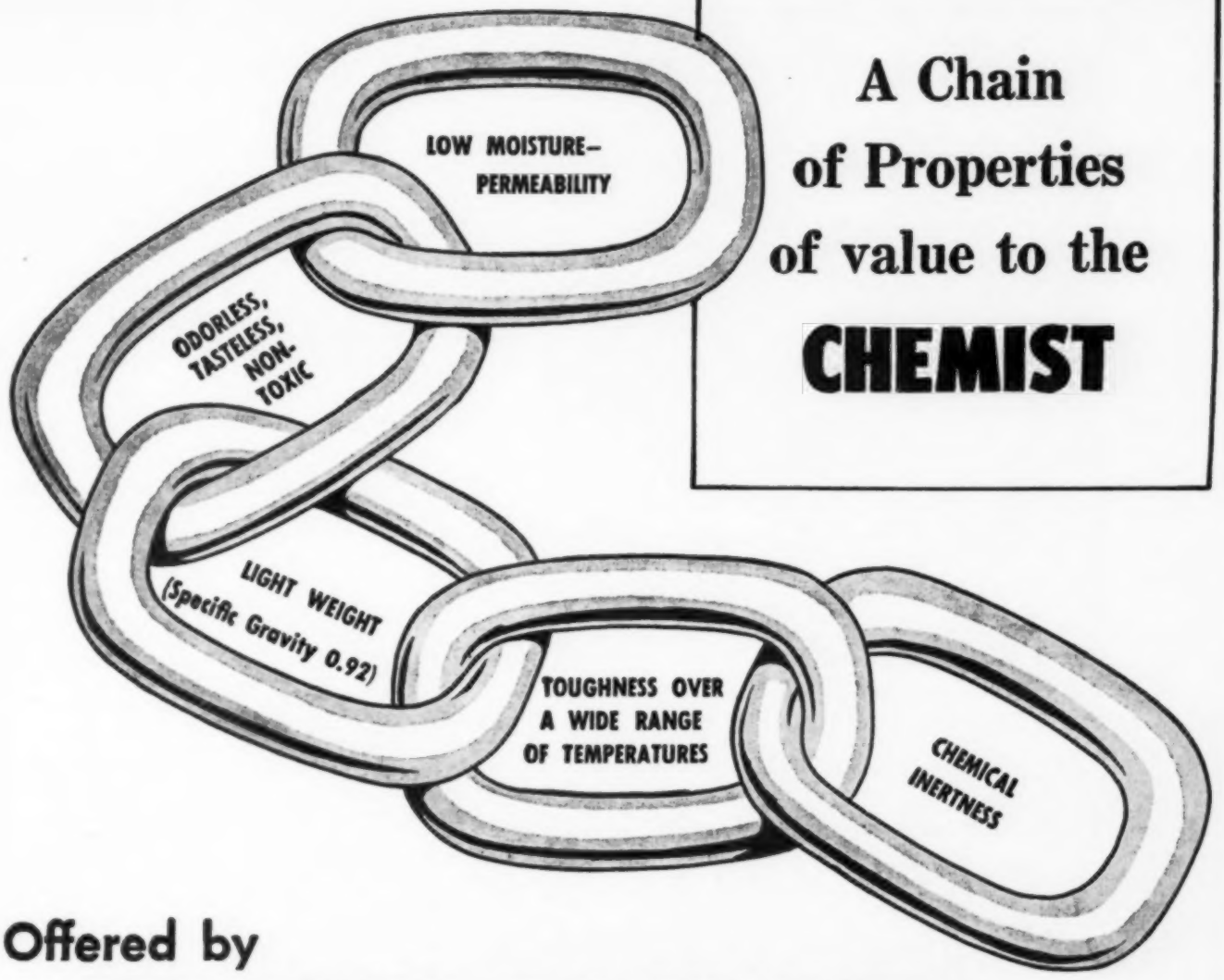

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University of Oklahoma, effective September 1. For the past few years Dr. Tonn has been engaged in research in the field of plastics and resins at the Massachusetts Institute of Technology.

Edwin R. Theis, professor of chemical engineering and head of the Division of Leather Technology of the Institute of Research at Lehigh University, has been invited to address the Faraday Society at its September meetings in London. His subject will be "Swelling and Shrinking of Proteins."

D. B. Keyes received an honorary doctor of science degree from the University of New Hampshire last month.

H. R. Copson, a research chemist of the International Nickel Co. was awarded the Charles B. Dudley Medal last month by the American Society for Testing Materials. The award was made at the society's annual meeting in Buffalo and was a recognition of outstanding original contribution on research in engineering materials.

John W. Michener of the Dorr Co. left last month for Germany where he will be chief of the Inorganic Chemicals Division of the Economic Division of the American Military Government, U. S.

Edwin M. Allen has retired from his post as chairman of the board of The Mathieson Alkali Works. Mr. Allen will continue as a director of the company.

Edward L. Cochrane, chief of the Bureau of Ships, U. S. Navy, **Harry Ingles,** chief signal officer of the Army, and **Lee A. DuBridge,** recently elected president of the California Institute of Technology, received honorary degrees for their wartime achievements last month at the annual commencement exercises of the Polytechnic Institute of Brooklyn. Vice Admiral Cochrane and Major General Ingles received degrees of doctor of engineering, and Dr. DuBridge received the degree of doctor of science.

John M. Blocker, Jr., physical chemist, has been appointed to the research staff of Battelle Institute, Columbus, and assigned to its division of non-ferrous metallurgy.

Joseph J. Strobel is now a chemical engineer in the Technical Division of the Office, Chief of Chemical Warfare Service in Washington. Major Strobel has had more than four years of active duty with the Army.

James E. Booge has been made chemical director of the Pigments Department of E. I. du Pont de Nemours & Co., a new position with headquarters in the Wilmington office. In addition, **E. R. Allen** has been appointed senior research associate reporting to the chemical director.

I. J. Krchma, previously assistant director of research at the Newport, Del., plant of E. I. du Pont de Nemours & Co., has been made assistant chemical director for white pigments.

W. F. Spengeman, research supervisor at the Newark, N. J., plant of E. I. du Pont

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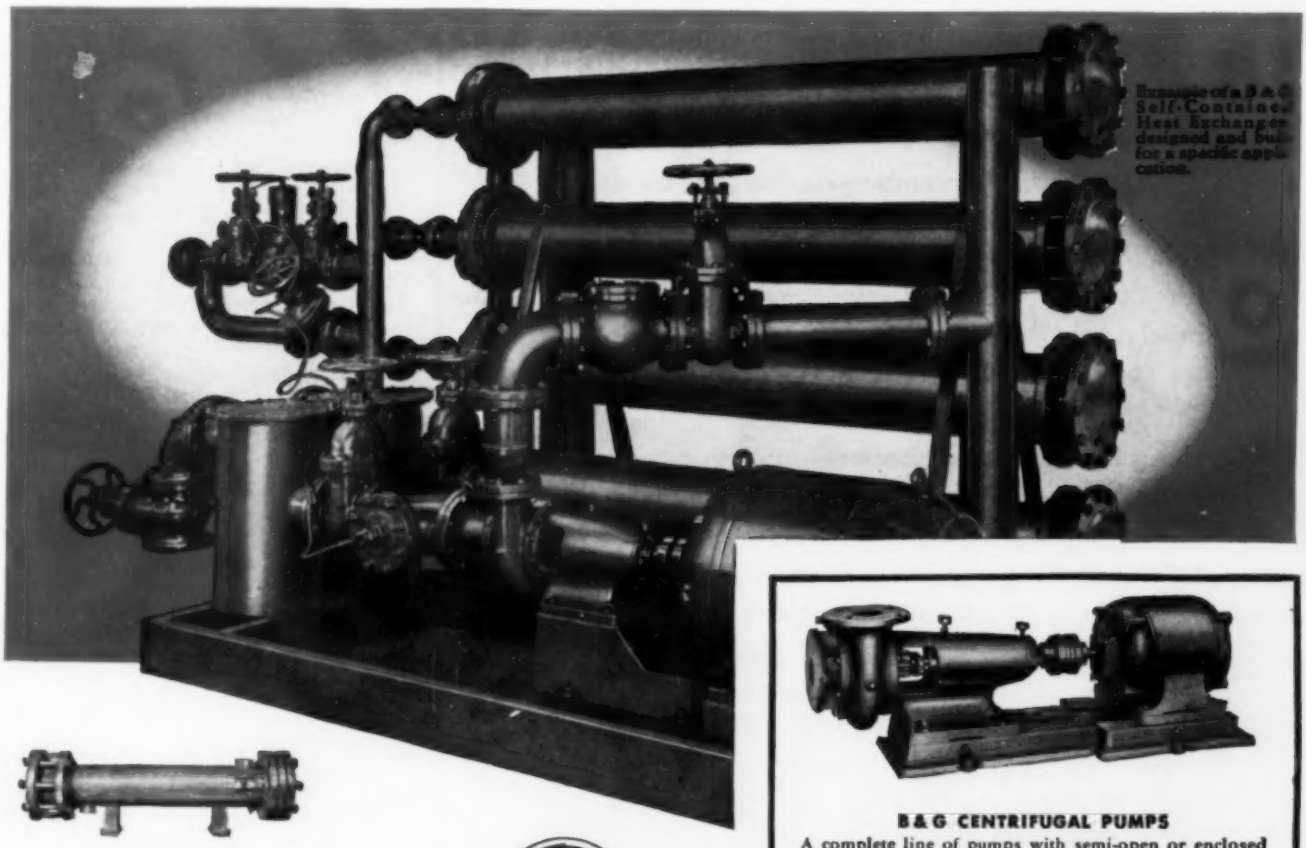

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de Nemours & Co., has been appointed assistant chemical director for color pigments.

W. Luther Lewis, who has been executive vice president of the Chicago Pneumatic Tool Co. since 1931, has been elected president to succeed **H. A. Jackson** who has relinquished the position but who remains chairman of the board of directors.

F. M. Anable has been appointed assistant to the vice president in charge of operations of Victor Chemical Works. He will make his headquarters at the general offices of the company in Chicago. **W. R. Dedert,** production superintendent of the oxalic and formic acid division in Chicago Heights for a number of years has succeeded Mr. Anable as production superintendent for the plant.

K. A. DeLonge, chemical and metallurgical engineer in the development and research division of the International Nickel Co., has been elected to the post of vice chairman of the Metropolitan Chapter of the American Foundrymen's Association to serve during the coming year of 1946-47.

Thomas K. Sherwood has been appointed dean of the School of Engineering at the Massachusetts Institute of Technology. Professor Sherwood has been deputy dean of engineering since last February as well as professor of chemical engineering. Dr. Sherwood succeeds Dean Edward L. Moreland, holder of the post since 1938, who has asked to be released so that he might return part time to the Boston firm of consulting engineers, Jackson and Moreland, from which he has been on leave during the war years. Dean Moreland will continue at the Institute as executive vice president.

Robert S. Aries has been appointed director of the Northeastern Wood Utilization Council. He was formerly field director, a position which will now be filled by **Richard J. Bandekow,** formerly of the plastics division of the Glenn L. Martin Co.

Roy G. Bossert will return in September to the faculty of the chemistry department at Ohio Wesleyan University as an associate professor. Since 1944 Dr. Bossert has been serving as an organic research chemist on an International Nickel Corp. project at Mellon Institute, Pittsburgh.

Bernard Grodin, of the Fuel Economy Engineering Co., has rejoined that firm after four and one-half years in the service. Mr. Grodin was in the navy, where he held the rank of lieutenant-commander.

Icie M. Hoobler, director of the research laboratory of the Children's Fund of Michigan, has been awarded the Francis P. Garvan Medal honoring women in chemistry. The gold medal will be presented in September at the national meeting of the American Chemical Society in Chicago.

J. E. Seebold is now assistant director in charge of process design and exploratory economics for the Standard Oil Co. (Ind.). Two other new assistant directors of research have been announced. They are, **Nathan Fragen,** in charge of pilot plant development work, and **B. H. Shoemaker** in

Need Advice about Machining Stainless Steel? -ask EASTERN!

Stack Drilling? What drill feed should be used in drilling ⅜-in. holes through clamped stacks of 20-gage, E-S 18-8 Mo stainless (Type 316) sheets?

Bevel Milling? In beveling E-S 18-8 low-carbon stainless (Type 304) plate edges before welding, must we decrease the speed or feed of the milling cutter as the cut widens?

Hole Size for Tapping? What diameter reamer should be used on holes in titanium-bearing E-S 18-8 plate (Type 321) to be tapped for ¼"-32 threads?

Saw Tooth Set? Is any special set required in the teeth of a band saw for cutting light-gage E-S 18-8 stainless sheet (Type 302)?

Punch-Marking? Can we punch-mark drill holes in E-S 18-8 chrome-nickel plate (Type 304)? What is the best way to start holes at an angle with this plate?

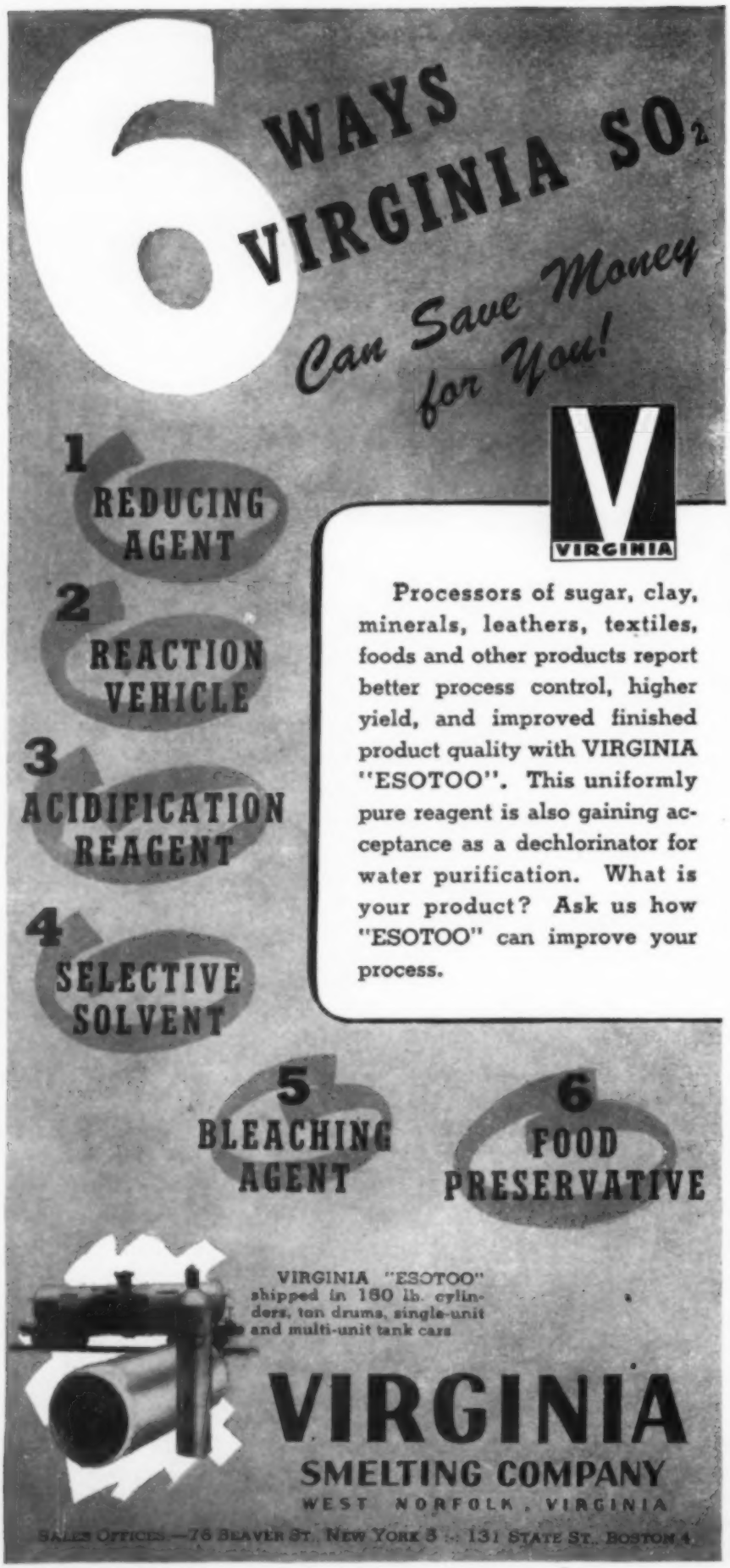
Counterboring? Is reaming likely to harden E-S 17-7 Stainless (Type 301) so much that counterboring is difficult? What is the remedy?

Machining stainless, like handling any other important metal, requires the right technique. When you know how, it is simple. When you need help, get in touch with Eastern. Eastern technical men have worked with stainless so much that they have the right advice at their fingertips. There is a lot of good advice, too, in Eastern's booklet, "Eastern Stainless Steel Sheets." A copy is yours for the asking. JMLco E-E1

ask Eastern for the answer when Stainless is the question

ES

EASTERN STAINLESS STEEL CORPORATION BALTIMORE 3, MARYLAND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charge of laboratory research on the production of chemicals from petroleum.

Marvin J. Udy has left for Santiago, Chile, to act as technical advisor to Fabrica Nacional De Carburo Y Metallurgia. This company manufactures calcium carbide and ferro-alloys in Chile and are expanding their present facilities. They also expect to enter the chemical field.

Frank J. Vosburgh, of National Carbon Co., Inc., has retired.

William W. Winship, Jr., of the Thermal Syndicate, Ltd., has been spending some weeks at the company's works, Wallsend-on-Tyne, England, in connection with new developments and techniques in vitreous silica manufacture.

H. Jermain Creighton, of Swarthmore College, has been awarded the Edward Goodrich Acheson Gold Medal and Thousand Dollar Prize of The Electrochemical Society. Presentation is scheduled for October 17, at Toronto.

Edwin G. Koch has been appointed professor of chemistry at Montana School of Mines, Butte, succeeding **Alfred E. Koenig**, who is retiring. Dr. Koch has been with the University of Texas staff since his release from the Army.

L. M. Roberts has become manager of the engineering Department of Shell Chemical Corp., San Francisco, Calif., in a recent reorganization of the development and engineering departments. **Martin Buck** will continue as manager of development.

OBITUARIES

Edgar L. Feininger, 56, assistant general manager of the Chemical Department of the General Electric Co., Pittsfield, Mass., died suddenly while attending a company outing at Lake George last month.

Howard W. Starkweather, 55, who directed research in the fields of elastomers and fine chemicals at the Jackson Laboratory of E. I. du Pont de Nemours & Co., Inc., Wilmington, died May 18.

Noel H. Hick, 62, a project engineer with the Austin Co., died in Cleveland May 24.

Eric E. Sommer, 34, sales engineer with the Linde Air Products Co., New Products Division, was one of the victims of the La Salle Hotel fire in Chicago June 5.

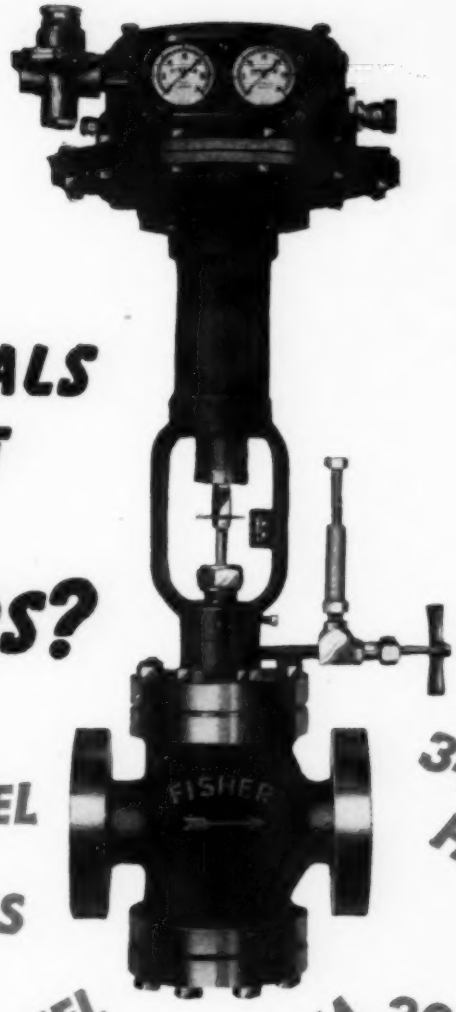
Charles E. Cummings, 79, assistant secretary of Raybestos-Manhattan, Inc., died June 6.

Rudolph L. Suhl, 63, manager of the Nickel Sales Department of the International Nickel Co. at New York, died suddenly at his home in Plainfield, N. J., June 10.

J. Coard Taylor, 45, vice president in charge of sales of Ethyl Corp., died in New York June 25.

Harold H. Fries, 80, president of Fries Brothers, Inc., manufacturing chemists, died in New York June 30.

WHAT MATERIALS DO YOU WANT IN YOUR CONTROLLERS?



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HASTELLOY C

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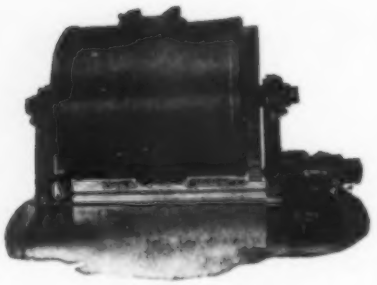

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INDUSTRIAL NOTES

Cleveland Crane & Engineering Co. has elected Herbert T. Florence president and general manager. A. C. Garnett was named vice president and treasurer, while W. G. Wehr was made secretary and W. D. Vanderbilt assistant secretary.

General Electric Co., Chemical Department, Pittsfield, Mass., has appointed George P. Lehmann to the newly created post of assistant manager of the plastics divisions.

Union Carbide & Carbon Chemical Corp., New York, has elected Gilbert P. Bogert to the post of president of the Oxweld Railroad Service Co., Chicago, a subsidiary of the parent company.

American Steel Band Co., Pittsburgh, has promoted Raymond J. Smith to be general sales manager, succeeding Carl R. Mirth who goes to the Pacific Coast as sales representative of the company in San Francisco and Los Angeles.

Edward Valves, Inc., East Chicago, Ind., has named D. O. Bayless to be special factory service engineer for the Southwestern United States. His headquarters will be in Houston, Tex.

Edwin L. Wiegand Co., Pittsburgh, is building a new plant to expand facilities for the manufacture of Chromalox electric range units and electric heaters for industry.

Ampco Metal, Inc., Milwaukee, has appointed R. S. Stover as supervisor of the Philadelphia-Washington district with headquarters in Philadelphia.

Calgon, Inc., Pittsburgh, has appointed Golden Latshaw as its sales representative for the Banox rustproofing treatment of steel and galvanized steel.

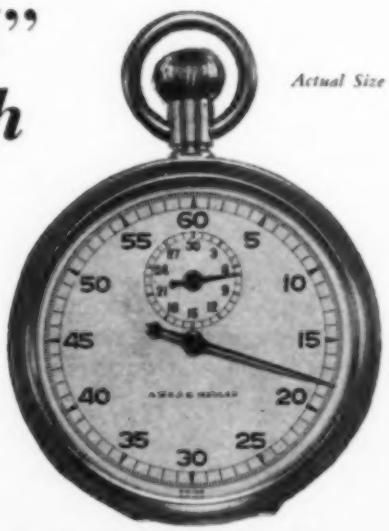
Tube Turns, Inc., Louisville, has announced the appointment of James H. Withers as district manager in charge of the firm's San Francisco and Los Angeles offices. S. M. Spears, Jr. has been promoted to assistant district manager of the New York office.

Gawler-Knoop, Inc., Newark, N. J., is the name of a new firm organized by Harry Gawler and Walt Knoop to provide a sales engineering service throughout the Middle Atlantic States.

C. M. Kemp Mfg. Co., Baltimore, is now represented by a new firm, Genn & Logan, in the territory including northern Indiana, northern Illinois, southwestern Michigan, and southern Wisconsin, Iowa, Minnesota, North Dakota, and South Dakota. The representative's office is located at 3959 N. Lincoln Ave., Chicago.

Minneapolis-Honeywell Regulator Co., Minneapolis, has purchased from the Heidbrink division of the Ohio Chemical & Mfg. Co. the two story plant adjacent to its main

"MEYLAN" *Stopwatch*



Actual Size

. . **"MEYLAN" Plain Fifth Second Timer; Perfect for laboratory and general timing.**

Long hand indicates 1/5 of seconds and seconds; completes one turn of the dial in 60 seconds. Small hand registers up to 30 minutes. Movement has seven jewels. Case is nickel, chromium plated. Non-magnetic. Unbreakable crystal.

OPERATION—Start, stop, and return to zero by successive depressions of the crown.

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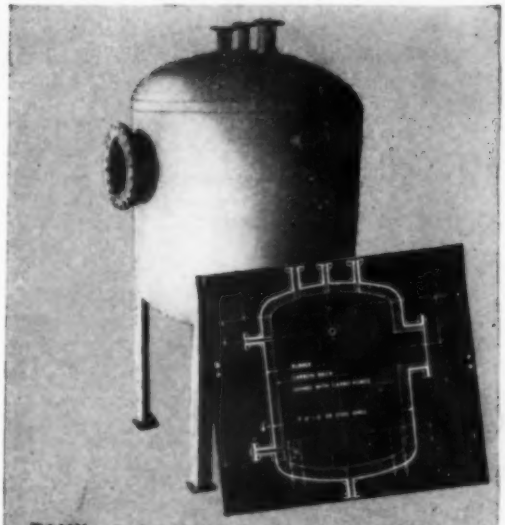

TANK. *Built of welded steel. Lined* with rubber, protected in turn with Atlas Carbo-KOREZ cement. Handles hydrofluoric acids, various corrosive salts . . . also used for Alkaline process, at temperatures approximating 230° Fahr.—under pressure.

ATLAS CERAMIC LINING, joined with Atlas ALKOR resin cement. Withstands various acids, alkalis, etc.—also severe abrasion and fluctuating temperatures.

FLOORS of Atlas construction withstand acids, corrosive salts, alkalis, organic solvents, live steam and severe mechanical punishment. Floor pictured is built of Atlas acid-proof brick, joined with Atlas ALKOR resin cement—over concrete sub-base which has been treated with Atlas plastic membrane.

FOR

Chemical Process Equipment

. . . LOOK TO ATLAS

"A"

"B"

TRENCHES—NEUTRALIZERS. "A" shows Atlas trench carrying acids for disposal and neutralization. This trench is lined with Atlas impervious membrane and protected with Atlas acid-proof brick, joined with Atlas Carbo-KOREZ. Handles corrosive wastes containing sulphuric acid, hydrochloric acid and chlorinated organic solvents, alkalis, etc., to neutralizing system. Atlas trenches obviate danger of acids seeping under buildings, attacking foundations and causing other material damage.

MANHOLES and SEWERS. "B" shows Atlas neutralizing tank which receives acid wastes:nitric, hydrofluoric, sulphuric and hydrochloric. Note acid-proof brick roof.

We offer a *complete service*—proven design, materials of construction and, if desired, supervision of installation. Atlas service brings you the benefits and economies that come only from long experience with every type of acid-proofing in every industrial field in which corrosives, alkalis, etc., are employed.

Contact a technically qualified Atlas representative at nearest listed branch office. Write us here at Mertztown for Technical Bulletin No. TV-10-C.

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*DETROIT 2, Mich., 2970 W. Grand Blvd.
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THE ATLAS MINERAL PRODUCTS CO. OF TEXAS, INC. Box 1023, Houston 1, Texas

*DENVER 2, Colo., 1921 Blake St.
*LOS ANGELES 12, Cal., 172 S. Central Ave.
*HONOLULU 2, Hawaii, U.S.A., Lewers & Cooke, Ltd., P. O. Box 2930
*SEATTLE 4, Wash., E. N. Hallgren Co., 1252 First Avenue, S.

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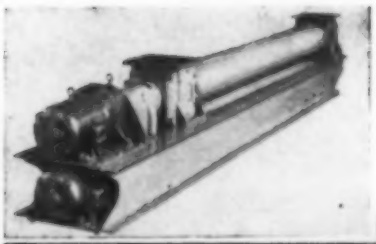
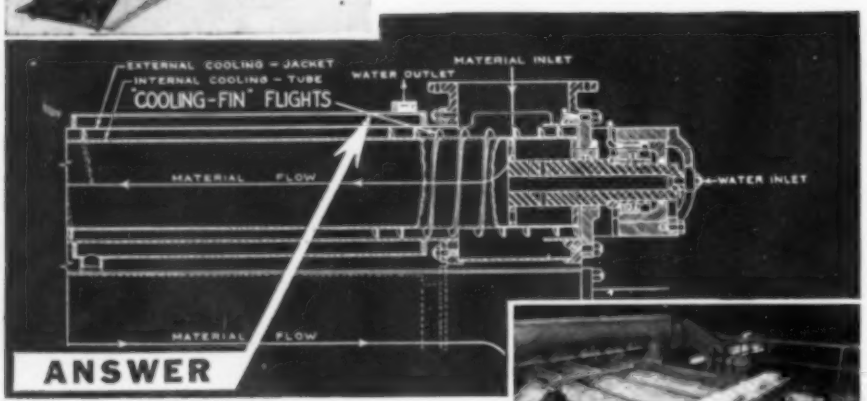
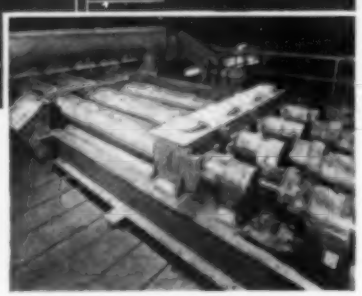
IN CANADA: Atlas Products are manufactured by H. L. BLACHFORD, Limited, 977 Aqueduct Street, Montreal, P. Q.

The $64.00 Question - - - Why Do Fuller Coolers Really Cool?







The Fuller Dry Pulverized-Material Cooler was built principally for the cooling of finished Portland cement. Also for elimination of difficulties encountered in handling and storing hot materials. Installations have now been in operation over an extended period in the cement and chemical-process industries.

The water-cooled screw which carries the material, the flights of which are specially welded to a hollow shaft, is designed on the same principle as the so-called "fin-tube", so successfully used by the refrigeration industry for efficient and rapid transfer of heat.

With this design and construction approximately 75 per cent of the heat extracted is carried off by the water circulated through the relatively large hollow screw shaft. The outer water jacket provides the remaining heat extraction.

These units are totally enclosed and dustless. The compact and rugged design makes for easy installation with minimum head room and support requirements.

Write for Bulletin PMC-1.

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PMC-13

plant in Minneapolis. The company's plastic molding department, including the plastics laboratory, has been moved into the new factory.

Diamond Alkali Co., Pittsburgh, has made J. Cline McKenna manager of glass industry sales and has named E. A. Robinson as technical assistant to the director of sales.

Pennsylvania Salt Mfg. Co., Philadelphia, has named Tom R. Todd divisional sales manager of the Southeastern district for the laundry and dry cleaning division. W. J. Zimmerman, recently released from the army, has been named departmental sales service representative for the Dallas, Tex., area. Edwin J. Petit, also released recently from the army, has been assigned as sales service representative in the south Florida territory.

Henry J. Kaiser Co., Oakland, Calif., has opened a Kaiser Export Sales New York office under the direction of William F. Pelletier. The new export division is located at 30 Church St.

Reliance Electric & Engineering Co., Cleveland, has appointed C. V. Gregory to the position of district manager in Pittsburgh.

Chicago Pneumatic Tool Co., New York, has appointed Robert A. Rankin as sales manager of the Diesel Engine Division. Mr. Rankin has been with the company since his graduation from Rensselaer Polytechnic Institute in 1928.

Kerotest Mfg. Co., Pittsburgh, has acquired the Security Valve Division of Security Engineering Co., Whittier, Calif. A new manufacturing plant has been purchased at Slauson and Alcoa Avenue, Los Angeles, where the company's products will be produced for Pacific Coast and western distribution. The name of the new company will be The Kerotest Pacific Co., a subsidiary of the parent Pittsburgh company.

Innis, Speiden & Co., Export Sales Division, New York, has appointed Frank T. Shanahan to the position of manager. Maj. Shanahan's office will be located at the company's headquarters, 117 Liberty Street, New York.

Hercules Powder Co., Wilmington, has promoted Walter E. Gloor to head the new products development section of the company's Cellulose Products Department. Courtland K. White has become plastics supervisor in the department.

First Machinery Corp., New York, formerly of 819-37 E. 9th St., has moved to new offices located at 157 Hudson St.

Houdry Process Corp., New York, has appointed Dr. Claude Peavy to head the company's process design division.

Hydropress, Inc., New York, has appointed Carl J. Lamb to the position of vice president. Mr. Lamb returned to civilian life after five years active duty in the Navy.

Washington Veneer Co., Olympia, Wash., has announced the appointment of Hal W. McClary as general manager. Former general

MODERN product research requires the use of every part of the spectrum for comprehensive analysis. Your research laboratory is not complete if it does not have equipment for X-ray examination.

Many research laboratories have found NORELCO X-ray equipment invaluable in eliminating existing "black-outs" of part of the spectrum. Unvarying patterns in the atomic structure of many materials can be determined most rapidly by X-rays. Other spectrographic means are unable to present the same data—only X-ray analysis can reveal the ultimate structure—the state of combination of elements.

NORELCO X-ray Spectrometric and Diffraction Apparatus can serve you in material analysis, product control, competitive comparison and research. Many times, better methods and products result from data they supply. These modern forms of analysis are essential to a sound competitive position or even leadership in industry.

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AMERSIL* ANNEALED SILICA
for HIGH PRODUCT PURITY at HIGH TEMPERATURE

Whether you are running a high temperature chemical reaction, collecting hot corrosive liquids, or refining or sintering metals, Amersil annealed silica equipment will give you a purer product. Non-porosity, high electrical resistivity at all temperatures, and the ability to withstand severe thermal shock are additional characteristics which make Amersil ware unique.

The properties and applications of Amersil annealed silica are such that they warrant your investigation.

Send for the Amersil Catalog and get the details.

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superintendent, McClary will assume the duties of E. E. Westman, who has retired from the presidency.

Interlake Chemical Corp., Seattle, has appointed John J. Bogner as Northwest sales manager. Headquarters will be at 1121 Smith Tower.

Pennsylvania Coal Products Co., Petrolia, Pa., has named Carl H. Pottenger to the position of vice president. Mr. Pottenger has served on special committees of the Solid Fiber Container Manufacturers' Association, Society of the Plastics Industry and the Plastics Materials Manufacturers' Association.

Link-Belt Co., Chicago, has opened three new sales offices. M. J. Parykaza, district sales engineer, is in charge of the new office at Moline, Ill. L. R. Clark, district sales engineer is in charge of the new office at Cincinnati, Ohio. C. C. Wiley is district sales engineer in charge of the new office at Birmingham, Ala.

Material Movement Industries, Chicago, is the new name of Coaltoter Conveyor Co. The name was changed to portray more accurately the company's equipment and activities in the material-handling field.

Metallizing Co. of America, Chicago, has moved its eastern office and warehouse to 431 East 75th St., New York.

Lukens Steel Co., Coatesville, Pa., has named Herbert G. Austin to be district manager of sales in the Boston office.

Nuodex Products Co., Inc., Elizabeth, N. J., has named Laurence E. Anderson to the post of regional sales manager on the West Coast. Mr. Anderson will make his headquarters in the San Francisco area.

United States Steel Corp., Chicago, has appointed Howard J. Mullin manager of sales of the St. Louis district for the Carnegie-Illinois Steel Corp.

City Chemical Corp., New York, has returned Milton E. Hill to the sales promotion staff following four years of service in the U. S. Navy.

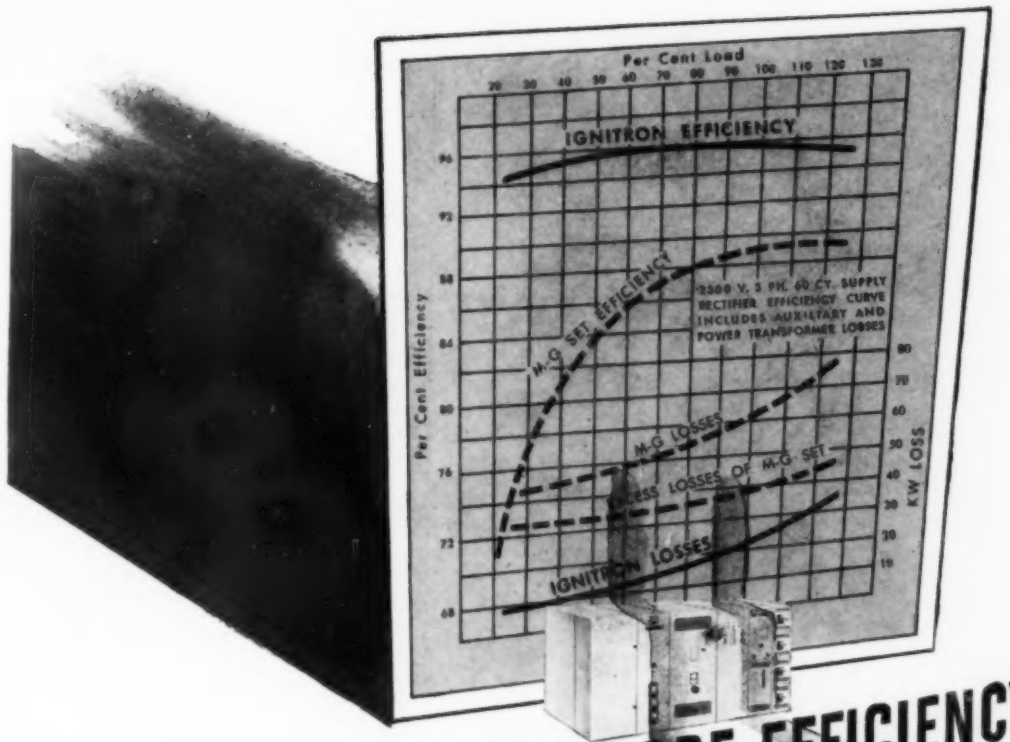
Hammond Iron Works, Warren, Pa., has appointed Pump and Tank Co., Inc., Richmond, Va. as its Richmond district representative.

Universal Pigment & Chemical Corp., Newark, N. J., has just completed a modern dry color plant. The unit will manufacture a complete line of organic lakes and toners.

Spencer Chemical Co., Kansas City, Mo., is the successor to Military Chemical Works, Inc. The company with key works located at Pittsburg, Kan., will manufacture chemicals for industry and agriculture.

Gerber Sales Co., Boston, has moved to new offices at 739 Boylston St.

Girdler Corp., Louisville, has made Arne Eriksen western representative of both the gas processes and the Votator divisions. Mr.



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. . . investigate the new Ignitron Unit Substation - - -

Maximum efficiency is today's keynote in industry . . . efficiency that keeps operating costs at a minimum.

The Westinghouse Ignitron Unit Substation has an efficiency advantage over the m-g set of approximately 19 percent at ¼ load to 7 percent at full load, for 600-volt, d-c service, and approximately 18 percent at ¼ load to 4 percent at full load for 250-volt, d-c service.

The fundamental method of operation of the Ignitron, with its intermittent excitation system and individual tubes for each anode with its own cathode, is responsible for the high efficiency. Reduction in shields and arc length results in reduced arc drop and provides increased efficiency for peak loads . . . light loads . . . 24-hour loads.

For economical, efficient power conversion . . . a-c to d-c . . . 125 volts, d-c to 600 volts, d-c . . . investigate the advantages of the Ignitron Unit Substation for *your* particular d-c power requirements. Write for B-3646 — "*Power Conversion At Its Best*" — Westinghouse Electric Corporation, P.O. Box 868, Pittsburgh 30, Pa.

J-10302

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Electronics at Work

HIGH on the list of adsorbents, where they have been for 35 years, you will find Floridin products. In the making of aviation gasoline, lubricating oils, synthetic rubber, and many chemicals, the most advanced and the most exacting processes are giving new proof of the effectiveness of these adsorbent products. A staff of technicians is employed to give aid and advice as users may require. If you have a problem of adsorption—dehydration—decolorization—catalysis, your inquiry will be given careful, competent attention.

Floridin
ADSORBENTS

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Eriksen will have his headquarters at 2612 Russ Bldg., San Francisco.

Truland Chemical & Engineering Co., Inc., Union, N. J., has completed expansion of its facilities to be used as a service for the recovery of a wide variety of liquid mixtures.

Arthur G. McKee & Co., Cleveland, has opened a sales office in Chicago. The new office will be in the McCormick Building. Macauley Carter is in charge at the new location.

Malcolm Pirnie Engineers, New York, is the name of a partnership which has been formed with Malcolm Pirnie, Ernest W. Whitlock, Robert W. Sawyer, G. G. Werner, Jr. and Richard Hazen. The firm will continue its engineering practice.

Allis-Chalmers, Milwaukee, has named R. N. Landreth to direct the activities of the company's Washington, D. C., district office. This is in addition to his other special duties as assistant to the vice president of the General Machinery Division.

The Bury Compressor Co., Erie, Pa., has elected B. C. O'Brien as president and general manager.

General Electric Co., Chemical Department, Pittsfield, Mass., has appointed Guy M. Stone as manager of the Coshocton, Ohio, plant. The Coshocton factory to be used for the manufacture of laminated plastics, is now under construction.

Advanced Cosmetics, Inc., New York, has been formed as a private brand cosmetic company.

Vulcan Iron Works, Wilkes-Barre, Pa., has established a new cement, lime and allied products division under the leadership of Mark R. Woodward and Leon D. Holden. Mr. Woodward has returned to the company after four years as chief engineer of the Plum Brook Ordnance Works. Mr. Holden, assistant director of the new division, is a graduate of Rensselaer Polytechnic Institute.

Shawinigan Chemicals, Ltd., Montreal, has opened a branch office at 66 King Street West, Toronto. G. K. Wright is in charge. The new office will also handle the sales of products of Carbide & Carbon Chemicals Corp. and Sharples Chemicals, Inc.

Ball Chemical Co., Pittsburgh, has moved from the Fulton Building to 507 Liberty Avenue in the Empire Building.

Warner Lewis Co., Tulsa, has acquired full ownership of Flotrol Systems, Inc., and has moved Flotrol headquarters from New York to Tulsa.

St. Joseph Lead Co., New York, has named Harry E. Outcault to the position of assistant sales manager of the Zinc Oxide Department.

Economy Pumps, Inc., Hamilton, Ohio, has purchased the stock of the Klipfel Mfg. Co. J. H. Swan remains with the company in an advisory capacity and as chairman of the board of Klipfel.

Where Freedom from Iron is a "Must" Use Hooker Sulfides

Eight parts per million (.000008 of a pound per pound of product) is as much iron as you will ever find in a pound of Hooker Sodium Sulfide. Manufacturing refinements and purification techniques developed by Hooker chemical engineers bring you this Sulfide that can be safely used in practically every case where an iron free sulfide is needed. And in Hooker Sodium Sulfhydrate the iron content has been brought down to a maximum of 5 parts per million.

Where your processes require sulfides, you can be sure of purity of your products by using uniformly high purity Hooker Sodium Sulfide and Sodium Sulfhydrate. A request on your company letterhead will bring Technical Data Sheets and samples.

SODIUM SULFIDE, Na_2S, a light yellow colored solid in flake form, soluble in water, slightly soluble in alcohol, insoluble in ether.

Analysis

Sodium Sulfide	60 to 62%
Sodium Chloride	1.5% Max.
Other Sodium Salts	2.0% Max.
Iron	8ppm Max.
All other metals	1ppm Max.
Water of Crystallization	36.5 to 34.5%

Shipping Containers, Drums 90 and 350 lbs. net.

SODIUM SULFHYDRATE, NaSH, a light yellow colored solid in flake form. Soluble in water and alcohol, insoluble in ether.

Analysis

Sodium Sulfhydrate	70 to 72%
Sodium Hydroxide	0%
Sodium Sulfide	1 to 2%
Sodium Chloride	1% Max.
Other Sodium Salts	1% Max.
Iron	5ppm Max.
All other metals	1ppm Max.
Water of crystallization	28 to 26%

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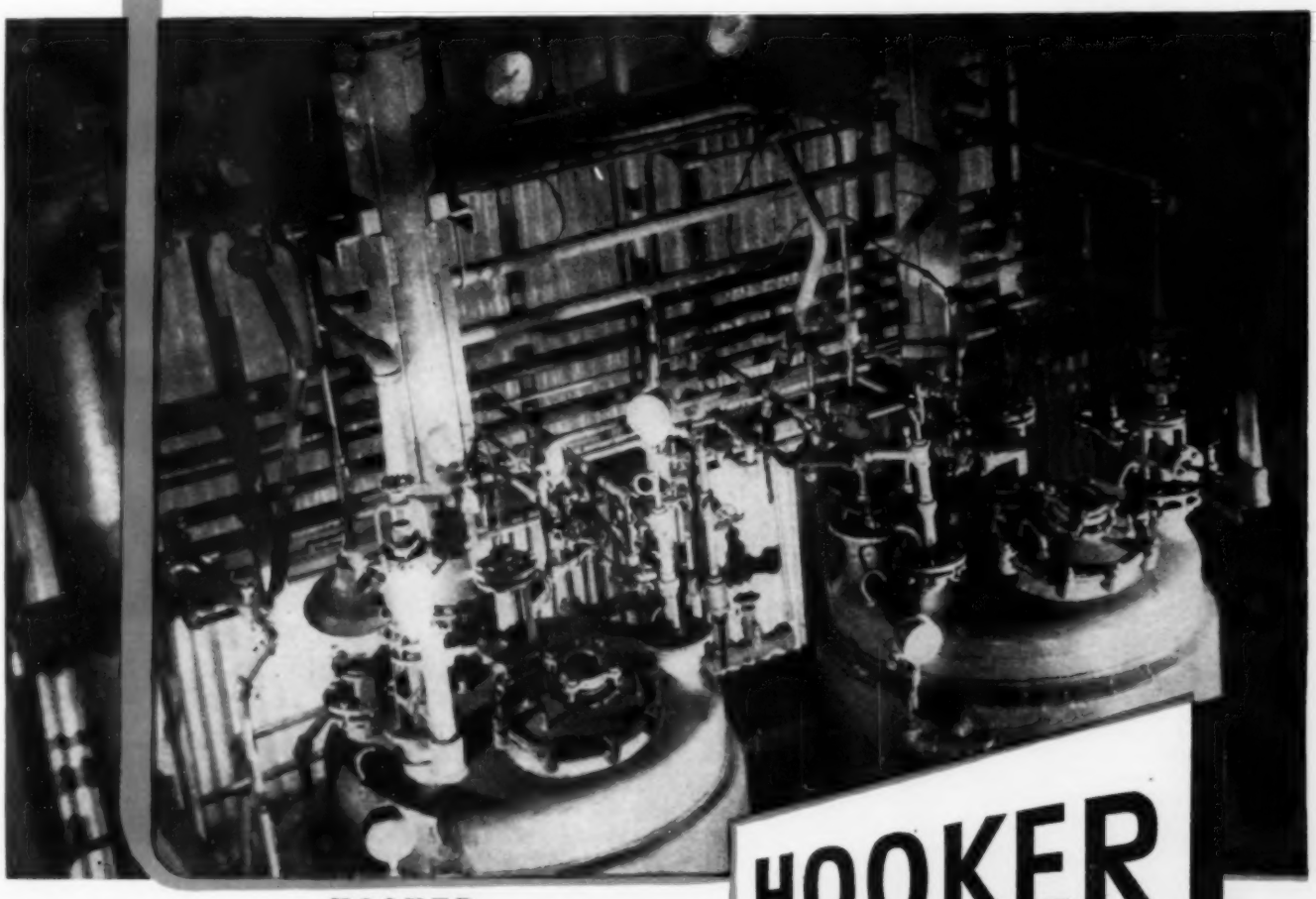

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CONVENTION PAPER ABSTRACTS

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SODIUM HYPOCHLORITE, A USEFUL CHEMICAL

SODIUM HYPOCHLORITE exists in a commercial form only as a solution which is generally yellow in color. The concentration most widely used is approximately 5 percent available chlorine for household purposes. Commercial bleaches with concentrations of 10, 15 and 20 percent are used by laundries, swimming pools, and water treating establishments.

The salt decomposes more readily in the higher concentrations especially in light or in higher temperatures, say 80 to 100 deg. F. The solutions in freezing separate out long slim needle-like crystals which redissolve when the temperature rises.

Sodium hypochlorite's most useful property is its oxidizing power, which is used to advantage in disinfecting and bleaching. Sodium hypochlorite decomposes very readily in the presence of iron, manganese, and nickel. It shows a violent reaction with sulphur.

Sodium hypochlorite can be prepared by neutralizing hypochlorous acid with NaOH. HOCl is prepared by passing chlorine over heated mercuric oxide to form chlorine oxide, which is then dissolved in water to form hypochlorous acid. The compound can also be made by dissolving chlorine in a solution of sodium hydroxide.

Hypochlorites produced so that all the caustic is used in the chlorination, seem to be superior in many respects to those containing free caustic. Most of the absorbing of chlorine is done in closed vessels. However, open vessels can be used. The temperature during the gassing period must be kept to a minimum. As the temperature increases, the rate of formation of sodium chlorate increases. In the presence of an excess of chlorine, the hypochlorite decomposes and chlorine is given off until the solution finally contains only sodium chloride. In the normal manufacture of NaOCl one molecule of sodium chloride is formed for each molecule of sodium hypochlorite.

Industrially sodium hypochlorite is widely used as a bleach in the production of paper pulp. However, mills do not often purchase sodium hypochlorite as such, but manufacture their own as they use it. The bleaching of cotton cloth also consumes large

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Here is a new process by Cochrane that is of vital importance to the manufacturer of pharmaceuticals, chemicals, beverages, food and other process-manufactured products. When the cost of pure water, commercially equivalent to distilled water, can be reduced to as low as one-twentieth of its present cost, the result is bound to show up favorably in terms of profits—and it is high time something should be done along these lines.

The process is the relatively new one of removing minerals or salts from water by ion exchange and acid adsorption. The water is first passed through a carbonaceous or resinous ion exchange (zeolite) which has the ability to exchange metallic ions for equivalent quantities of hydrogen. The effluent is then passed through a resinous material which adsorbs the mineral acids. The carbonic acid which has been unchanged by the process, if objectionable, can be removed by passing through a Decarbonator.

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quantities. This bleaching is done, not only at the mills, but in laundries and in the household, where it is widely used for stain removal as well as bleaching. A sodium hypochlorite which contains no free caustic will bleach faster than one which contains a higher caustic content.

Most metals are very readily corroded by sodium hypochlorite; however, rubber, glass, lucite, ceramics, ethyl and butyl polymers are very resistant.

Mark M. Morris, Clorox Chemical Co., before California Section, American Chemical Society, Berkeley, March 11, 1946.

MAIL QUESTIONNAIRES IN INDUSTRIAL MARKETING

Mail questionnaires are a valuable tool of real use in market research. And like a tool, the job being done dictates whether or not it should or should not be used. The full time field man, the resident investigator, the telephone call, the personal contact, telegrams, library research and other methods of getting information are each useful in their turn. Mail questionnaires can secure as accurate and valuable information for the jobs that mail is fitted to do as the field interview for the jobs that it does well. The reliability of the research in either case depends not so much on the method but in the skills of those applying the method.

Mail surveys have certain advantages. One important consideration in survey work is to make sure that all those questioned are asked a question in the same way so that the correct interpretations of the reply can be assured. The mail questionnaire will wait hours or days for the respondent to come home to be interviewed. The mail questionnaire will travel to towns or homes so isolated that it would be too costly to call them personally. In using mail you also get away from the natural tendency of the man being questioned to impress the interviewer. The mail questionnaire frequently gets better comments as there is more time for a studied and considered response. Mail also gets away from the cheater problem which haunts field work. Mail frequently can produce more returns per dollar than field which not only makes possible a better geographically distributed sample but allows for better cross tabulations as the subdivisions of a larger number of returns have greater reliability.

There is much information which mail questionnaires having proper controls can receive: buying influence, markets, competition, product analysis and application, and distribution and sales.

Validity of a survey should be of constant concern no matter whether the survey is handled by mail or field. How the question is asked, who receives and returns the questionnaires, the size of sample, the list and other factors are involved. Much general criticism has been directed at the mail questionnaire which has not been justified.

Due caution must of course be exercised in interpreting mail questionnaires and as well as field surveys. Even though geographical response might be in proportion to the sample mailed, the response from buying functions might vary. As experience and statistical checks accumulate, more proof is available to demonstrate that prop

FACT NO. 1 Hammond Multi-Wall Bags are *economical.* First cost is the *only* cost. No handling, cleaning, storage or freight charges on "returned containers." No "returned bag" nuisance.

FACT NO. 2 Hammond Multi-Wall Bags are *sanitary.* They provide adequate protection against insect infestation, dirt, cinders, etc., assuring content purity and cleanliness. Also sift proof to keep the product "in" and the dirt "out."

FACT NO. 3 Hammond Multi-Wall Bags are *strong.* They are built to stand rough handling and to "deliver the goods" without loss or damage.

FACT NO. 4 Hammond Multi-Wall Bags are *weather-proof.* Rain, snow, sleet and leaky cars hold no terrors for shippers of these containers. Special *moisture-proof plies* for products requiring extra protection.

FACT NO. 5 Hammond Multi-Wall Bags are *convenient.* They are not only easy to handle, but also easy to pile, easy to open and easy to use!

FACT NO. 6 Hammond Multi-Wall Bags are *attractive.* Bright multi-color printing identifies your company, brand and product to the ultimate consumer—*your* customer.

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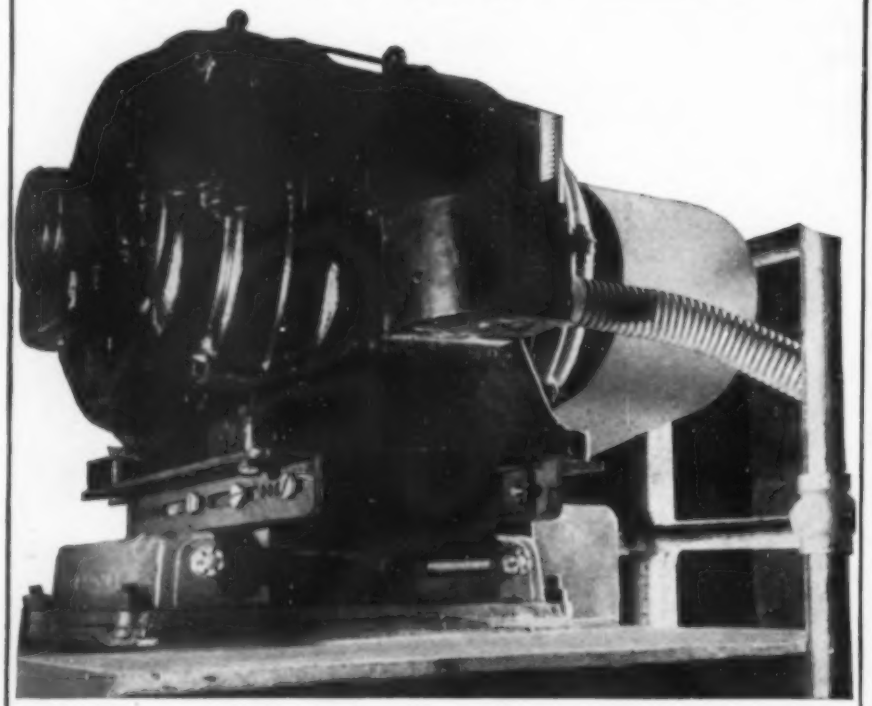

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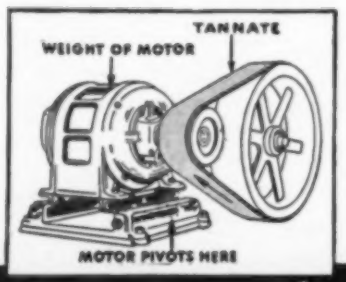

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erly used mail questionnaires are highly reliable.

People in industry are anxious to help if they are convinced that the request is a legitimate one. No premium or offer of benefit or reward is necessary. Those normally addressed in industry need not be tricked into replying. A straight-forward statement as to the purpose of the survey is all that is needed to secure replies from those that have the information. Nor does the respondent particularly want to remain anonymous.

There are many devices that stimulate response. A three cent stamp on the return envelope frequently doubles the return over a business reply envelope. A slip attached to the letter pointing out how valuable a large return would be invariably increases the responses materially. A friendly informal letter outpulls a stiff letter. A third class mailing is as effective as a first class one.

Mail questionnaires are, in effect, business letters on a production basis. Industry has always relied on business correspondence to supplement personal contact. Properly handled mail questions can be as accurate and informative as business correspondence with the added advantage of a greater value of information and a greater chance for comparison and interpretation.

John C. Spurr, McGraw-Hill Publishing Co., before Chemical Market Research Association, New York, April 25, 1946.

CIVILIAN RESEARCH FOR MILITARY PROBLEMS

At the start of the European war this country was emerging from several years of depression during which government budgets had been sharply reduced. Staffs of government laboratories were small and their equipment meager, and there had been insufficient funds. Research on items of war had to be rapidly expanded. The NDRC chose to use, wherever possible, existing research facilities in academic institutions, research institutions and industry in order to save time. Most of the early key positions were filled by academic men, many of whom had never worked in large organizations and few of whom had had military experience. Much time was accordingly wasted in getting started.

There was a natural skepticism, on the whole, in the Army and Navy as to the usefulness of a bunch of scientists. There were some jealousies and suspicions and other conditions leading to a feeling of frustration which was only gradually overcome by the scientists. During the first years of its existence, NDRC suffered some lack of effectiveness because its personnel did not know which problems were important and because military officers, few of whom are competent to direct scientific research, tried to give orders to OSRD. In some areas there was a feeling of open rivalry and hostility between civilian and military groups.

Several lessons can be learned from conditions existent early in the war. It is evident that military requirements for many items in modern war cannot be specified by the armed forces without the aid of scientists. Probably the greatest lack was intimate contact between laboratory workers and military men. By the end of the war this condition had been largely elim-

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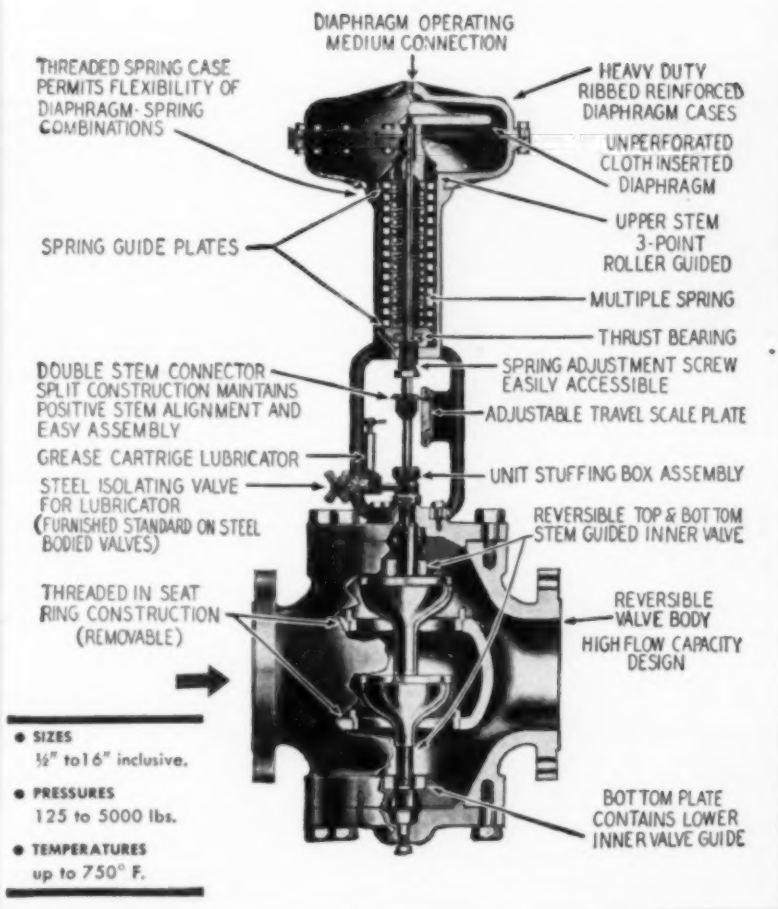
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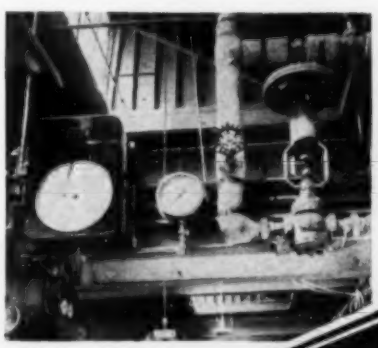

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inated. A third lesson is that never again should this country enter a war without having a large group of scientists thoroughly familiar with military procedure and problems. Some mechanism must be devised to provide that officers know many scientists. At the start of another conflict scientists must be sent to the front at once so that they can ascertain important problems at first hand. Another point is that some research work must go on in the war theaters.

The following recommendations are made as a basis for discussion:

(1) Army and Navy technical organizations should be headed by civilians not obligated to follow military orders. Salaries should be attractive.

(2) All scientists should be kept out of uniform so that the incompetents can be displaced and so that no stigma is attached to those who are not in the Army or Navy.

(3) Much development work on materiel must necessarily be performed by the armed forces, but long-range research should be contracted with civilian groups.

(4) More advisory panels and boards for the armed forces should be set up if for no other reason than to facilitate personal contacts and cement friendships.

W. A. Noyes, Jr., before First Annual Meeting of Chemical Warfare Association, Edgewood Arsenal, Md., May 24, 1946.

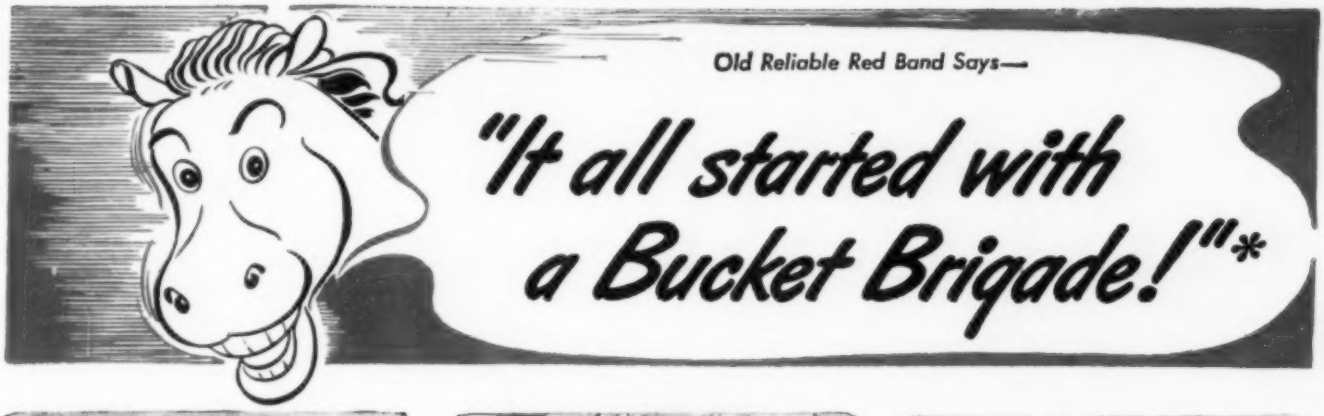
INDUSTRIAL RESEARCH AT THE UNIVERSITY

THERE remains a wide gap between industry and the university which can be bridged if we understand that the modern university must not only continue to conserve and interpret past knowledge but must also meet a vital need by conducting short and long term investigations in all branches of human endeavor. Scientific investigation must not be restricted to physical sciences nor should it be confined to so-called pure research.

The modern university must provide facilities which permit the undertaking of investigations which have practical applications and should not fail to realize the significance of any new discoveries that it may make. The university must create an atmosphere which will counteract the present tendency for a student to stop thinking once he has received his diploma.

Intense investigation of practical applications of theoretical knowledge which has taken place during the past five years has reduced our reserve of fundamental knowledge. An attempt must be made to overcome this deficit. This cannot be accomplished if we continue to invest only 5 percent of our total research expenditure for fundamental investigations. Before the war, 15 percent of our research was fundamental, but in other countries an equal amount was appropriated for both fundamental and applied investigations. American industry is contributing millions of dollars annually for fundamental research, but larger sums must be appropriated if we are to hold our present position in the world of science.

Both pure and applied investigations are conducted in university research institutes and, in this environment, the significance of new discoveries are more apt to be realized than in laboratories where practical research is avoided. We will never be able to build



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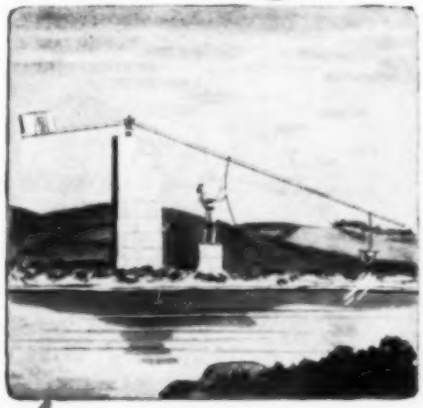

1 **Earliest recorded** mechanical waterworks system was known as the "*Shadoof.*" Water was scooped for the Pharaohs' water supply out of the Nile. . . . Relays of slaves worked chains of buckets, day and night. . . . In 1485 B.C., the exiled brother of Rameses II took this method to Greece.

2 **As early as 300 B.C.,** miles of crude, hand-made aqueducts were carrying water from Alpine springs to Rome, where matrons filled household water jars at public fountains in the streets. . . . Early American colonists dug community wells—built cisterns to catch rain water.

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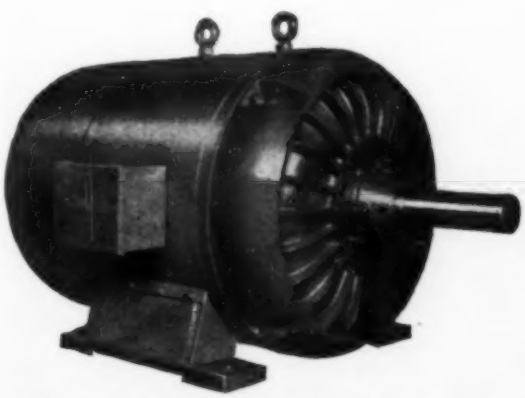

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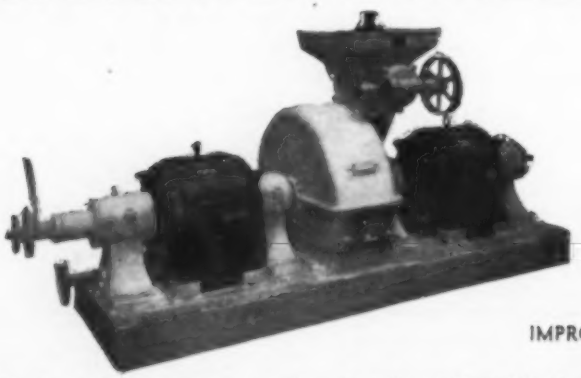

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up the vast reservoir of unapplied fundamental knowledge that formely existed because industrial research scientists know the importance of such knowledge and are continually examining new discoveries to determine if they have any practical applications to the problems of their industry.

The staff of a university research institute must be familiar with academic and industrial problems and, thus, is able to provide a broader training for graduate students. If this staff is properly selected and its members are permitted to teach one course a semester at a graduate level, a university can provide training of a quality that cannot be obtained in any other way.

Raymond B. Seymour, Industrial Research Institute, before Middle Tennessee Technical Society, Columbia, Tenn., April 1946.

PREPARATION OF BERYLLIUM POWDER

Though the literature on the electrodeposition of metals is voluminous, little is to be found concerning beryllium. Beryllium has been deposited from solutions of beryllium chloride and beryllium nitrate in liquid ammonia. It has also been deposited from beryllium iodide solutions in liquid ammonia.

Commercial methods for the production of beryllium by the electrolysis of fused salts have been developed in Germany, the United States, and Great Britain. These processes require such a high temperature that the metal is not in powder form without further processing. Therefore, desirability of producing beryllium powder at low temperature is apparent.

For our experiment a mixture, containing 49 mol percent beryllium chloride and 51 mol percent sodium chloride, corresponding to the eutectic composition, was used as the electrolyte. The melting point was found to be 218 to 245 deg. C. instead of 215 deg. C., as recorded.

A carbon rod with a diameter of 1 cm. was used as the anode and a plate 3 cm. of nickel as the cathode in a 5 cm. diameter pyrex cell. The electrolyte was kept at 220 to 245 deg. C. by means of an oil bath. The current source was a 6 v. storage battery. The current density was 1.33 to 1.5 amp. per sq.cm. A current of hydrogen was passed through the system during the run.

After two hours' operation, considerable black deposit had collected at the cathode and some was dispersed in the fused salt. The cathode was removed and the deposit washed with saturated ammonium carbonate solution which dissolved the thin film of beryllium oxide. This was followed by a thorough washing with distilled water.

Beryllium may be produced by the reduction of its oxide, its halides and its sulphide. No one of these has, however, been commercially successful.

In view of the higher affinity of sodium metal for chlorine as compared with beryllium metal it seemed worth while making a further study of the production of beryllium powder by sodium.

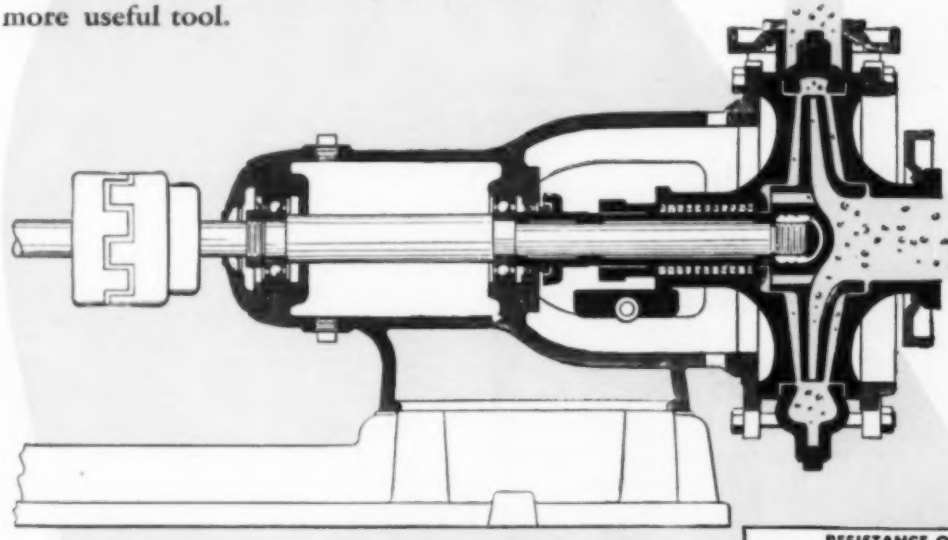
The regular combustion electric tube furnaces were used, the longer one for heating the beryllium chloride and the shorter one for vaporizing the sodium. A high yield of high purity beryllium powder

NEW BJ CORROSIRON* ACID RESISTING PUMPS

A new line of centrifugal pumps, remarkably resistant to the corrosive action of most acids.

Pumping highly corrosive liquids is a tough job, a job that requires rugged pumping equipment of a specialized nature. And the new BJ Corrosiron Acid Pumps meet the requirements with new maximums of usefulness and economy. We are pleased to offer industry a more useful tool.

All pump parts that contact pumped liquid are of Corrosiron, as indicated by solid black cross-section areas in illustration. BJ Corrosiron Acid Pumps are of horizontal, single stage, end suction, closed impeller construction, with heavy ball-bearing bracket mounted on cast iron baseplate. Furnished with flexible coupling for direct connection to driver. Sizes: 1½" to 3"; Capacities: 30 to 425 gpm; Pumping Heads: 20 to 140 feet; Speeds: 1150, 1450 and 1750 rpm.



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Corrosiron resists the corrosive action of sulphuric, nitric, and acetic acids at all concentrations and temperatures. It resists the corrosive action of many other acids to a degree dependent upon concentration and temperature. Test figures shown at right are interesting. The figures are from government, university, and commercial testing laboratories.

Corrosiron also resists the corrosive action of hydrofluoric, sulphurous, and hydrochloric where low concentrations are encountered below 5 or 10 percent.

INGENIOUS ENGINEERING

The brittleness and low tensile strength characteristics of high silicon irons pose unusual problems in engineering a centrifugal pump. But special care and the ingenious application of many years of experience provide the solution. These new BJ Corrosiron Acid Pumps are engineered for years of heavy-duty, trouble-free operation.

We invite inquiries about the application of BJ Corrosiron Acid Pumps to the pumping of corrosive liquids.

RESISTANCE OF CORROSIRON TO CHEMICALS
(STILL SOLUTIONS AT ROOM TEMPERATURE)

CONCENTRATION	CHEMICAL	LOSS, DEPTH IN. PER YEAR	CONCENTRATION	CHEMICAL	LOSS, DEPTH IN. PER YEAR
90%	Acetic Acid	.0000048	7.9%	Oxalic Acid	.0000234
27%	Ammonium Chloride	.0000183	Comm'l	Oleic Acid	None
25%	Antimonous Chloride	.000037	10%	Phosphoric Acid	.0000232
5%	Benzoic Acid	.0000076	25%	Phosphoric Acid	.0000116
1½%	Bleaching Powder	.0000073	87%	Phosphoric Acid	.000019
25%	Citric Acid	.000133	31%	Pyrogallic Acid	.000014
25%	Copper Sulphate	.0000102	1.39%	Picric Acid	.0000051
48%	Ferric Chloride	.00414	9.1%	Picric Acid	.0000051
50%	Ferric Sulphate	.0000075	10.75%	Potash Alum	.0000115
25%	Formic Acid	.00029	25%	Potassium Bromide	.00029
5%	Hydrochloric Acid	.00145	19.4%	Sodium Carbonate	.000052
25%	Lactic Acid	.000048	25%	Sodium Chloride	.000285
25%	Magnesium Chloride	.000035	18%	Sodium Hydroxide	.000022
25%	Monochloracetic Acid	.000052	10%	Stannous Chloride	.00000165
10%	Nitric Acid	None	25%	Sulphuric Acid	.0000173
25%	Nitric Acid	None	95%	Sulphuric Acid	.0000208
70%	Nitric Acid	None	20%	Tartaric Acid	.0000068
2.1%	Oxalic Acid	.0000306	20%	Zinc Chloride	.000036

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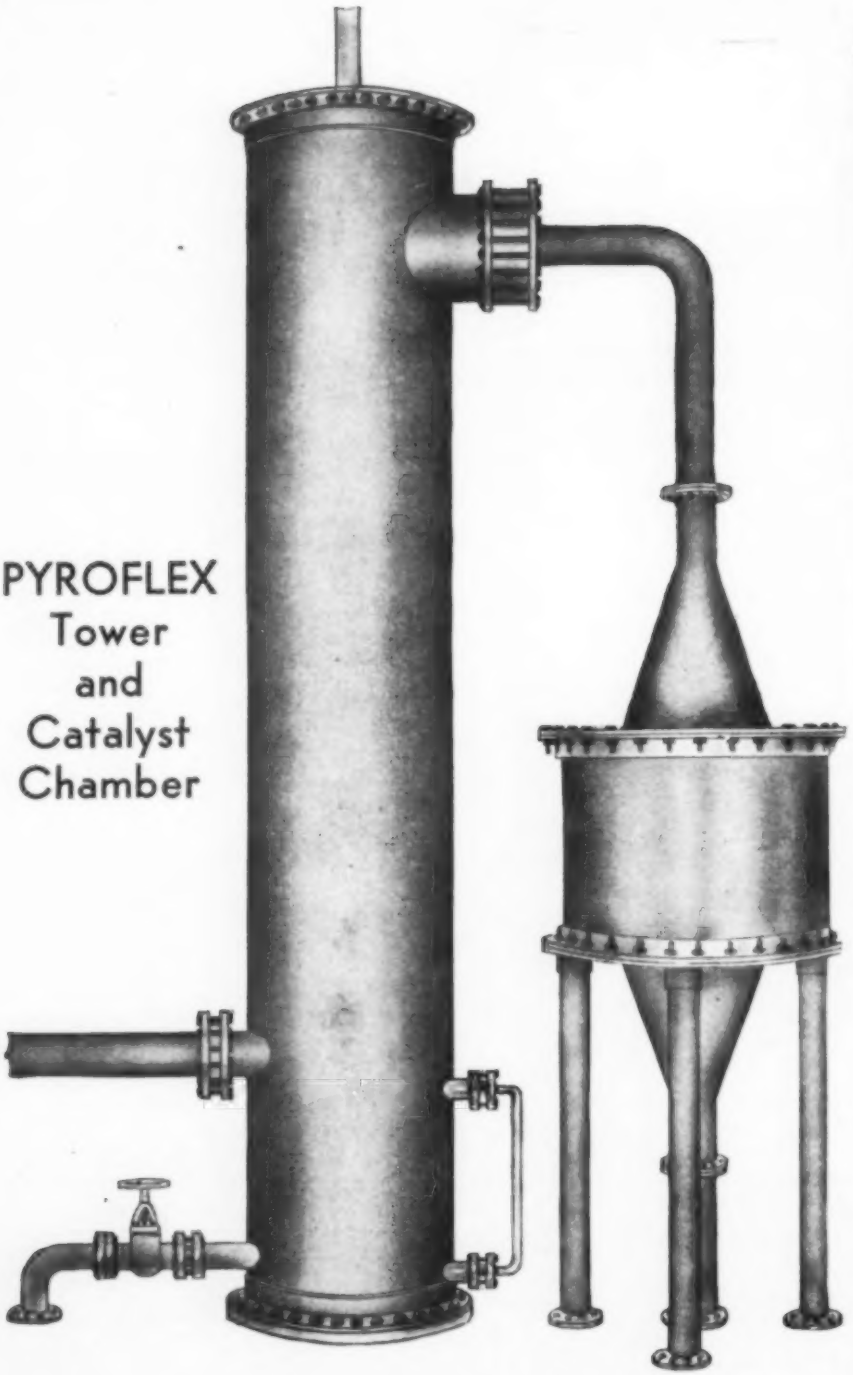

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Above is a catalyst chamber and tower for the production of organic acid. They are of Pyroflex construction, designed to withstand corrosives at high temperatures.

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This equipment is another example of Pyroflex Functional Units designed and constructed by Knight to solve a problem and meet the exact needs of a customer.

Maurice A. Knight 106 Kelly Ave., Akron 9, Ohio

was prepared by the reduction of the beryllium chloride. This method is preferable to others for the production of beryllium powder which is finding wider uses in the rapidly expanding field of powder metallurgy.

J. M. Tien, The Texas Co., before The Electrochemical Society, Birmingham, Ala., April 1946.

WHAT'S LEFT IN GERMANY

THE WORLD, devastated by war, needs large quantities of American goods. The chemical industry serves all lines of manufacture as well as agriculture, and the volume of our production during the next several years should continue to be heavy. The demands on the industry are increased still more by the fact that the chemical industry of Germany has, at least temporarily, been put out of production. According to authoritative information the I. G. Farbenindustrie's current production in the American zone is now no more than 20 percent of capacity because of lack of fuel, transportation, and raw materials, but not because of lack of capacity, equipment and facilities or lack of trained personnel. We are told that most of the plants still standing could be in full production in three to six months. American investigators who have inspected these plants express doubt of this possibility. They report that practically all the bridges in Germany are damaged or destroyed, that the rivers are unnavigable so that water transportation is out, and the big rail centers are badly damaged. According to information furnished us 21 of the 42 major munitions plants in the American zone have either been destroyed or designated for reparations. Two of the big Montan war plants have been completely wrecked, and others have had their war potentials removed. The nitrating towers of Fabrik Ashan, valued at eighteen million dollars, have been blown up. Present operation of the remaining plants is confined to the production of essential items only, such as drugs and articles for sale to the Army of Occupation.

However, the future possibilities of the German chemical industry are something that we must take into account. A large number of the newer plants are in the Russian zone of occupation, and these have either been removed or will be placed in operation under Russian management, and they may become an important factor in world commerce. It is reported that the Allied Control Council plans for German industry call for chemical production in 1949 of over 60 percent of the 1936 output.

If permitted to rehabilitate its chemical industry Germany again may become the nucleus of a war production machine as it was in the two World Wars.

H. L. Derby, American Cyanamid & Chemical Corp., before Manufacturing Chemists' Association, Skytop, Pa., June 6, 1946.

PETROLEUM FROM COAL MINES

JUST as sulphur is melted in the ground and pumped out in liquid form, it is not too fantastic to believe that with cheap oxygen, coal may be burned in the mine. The heat generated in the gases and the subsequent

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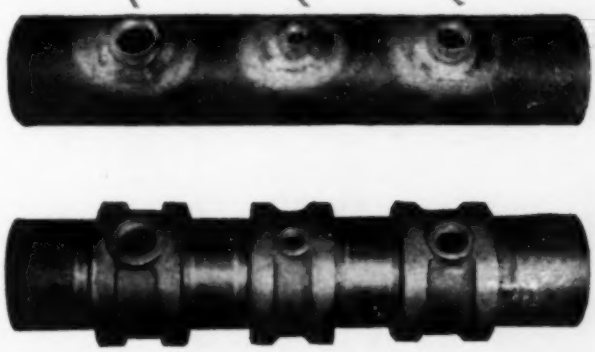

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burning of the carbon monoxide would provide the power for a utility plant near by. The carbon monoxide might also be reduced to petroleum. With the present conditions in the coal industry, investigations of this kind may be stimulated which, by past experience, generally result in inventions or discoveries for replacement of labor by mechanized processes.

The liberal supply of petroleum in this country has led to the relative neglect of the study of synthetic fuels from coal or from carbon monoxide, problems which were of highest priority in German research. The United States still has a large reserve of petroleum, but by no means an inexhaustible one. The importation of petroleum to maintain our reserves will probably continue as a future policy, but an intensive effort should soon be initiated to discover other methods of implementing our fuel supply. The catalytic oxidation of natural gas to carbon monoxide and hydrogen represents a paper reaction which may be fulfilled in the laboratory. From these products conversion to petroleum could follow by established procedures.

Roger Adams, University of Illinois, Remsen Memorial Lecture before Maryland Section, American Chemical Society, May 24, 1946.

SYNTHESIS OF FLUORENE AND FLUORANTHENE

Passage of 2-methylbiphenyl in the vapor pase at 500 deg. C. over a palladium catalyst results in its conversion to fluorene. The conversion can be made nearly quantitative by recycling the unchanged starting material, and this reaction provides a simple, new method of obtaining synthetic fluorene.

In the synthesis of fluoranthene by means of the "cyclodehydrogenation reaction" starting material is obtained from the Grignard condensation of 1-naphthylmagnesium bromide with cyclohexanone. The carbinol which results from this reaction is dehydrated to 1-(tetrahydrophenyl)-naphthalene. When this compound was treated with a palladium catalyst at 500 deg. C. it was converted to fluoranthene. A catalyst composed of 12 percent chromia on alumina is superior to palladium in the reaction.

It is of interest to note that fluorene and fluoranthene occur in large quantities in the tar from coal carbonization. The cyclodehydrogenation reaction not only helps to explain the occurrence of many polynuclear compounds in coal tar but opens up new methods for obtaining in a simple fashion various pure synthetic polynuclear compounds.

Milton Orchin and Leslie Reggel, Bureau of Mines, before Organic Division, American Chemical Society, April 9, Atlantic City.

STRUCTURAL CHEMISTRY

Modern structural chemistry differs from the older science in being precise—quantitative, instead of qualitative, lucid, instead of vague. The methods of modern structural chemistry are largely physical in nature. They include molecular spectroscopy, the determination of the configuration of gas molecules by the diffraction of electrons, the measurement of the electric dipole moments of molecules, the measurement of magnetic moments and of diamagnetic susceptibilities,

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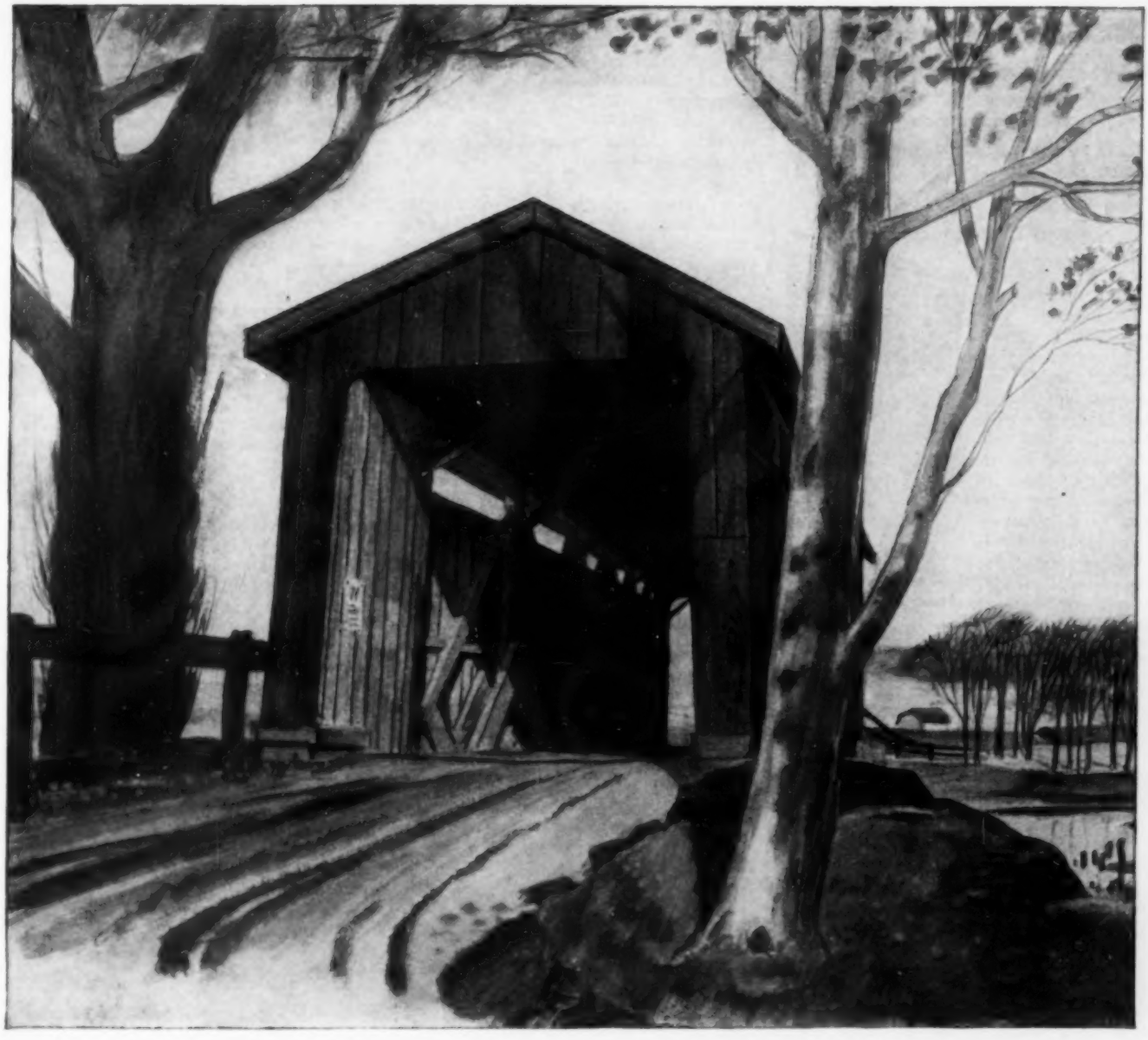

Why did old bridges carry umbrellas?

The covered bridges that once dotted the highways of the country weren't built to protect the traveler . . . but the bridge itself. By shielding the trusses, decking and stringers from moisture—which permits the fungus growth that causes decay—the life of the bridge was extended.

Today there is the same necessity of protecting not only bridges, but all sorts of structures from the accelerated decay produced by moist conditions: building frames, roofs and walls in humid atmospheres; timbers and flooring laid at grade or subgrade; piling and piers.

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the interpretation of heat capacity, entropy, and other thermodynamic quantities, and the application of theory, especially quantum mechanics. Each of these methods, in addition to providing the specific detailed information characteristic of it, has led to significant additions to our body of general chemical knowledge.

The field of application of modern structural chemistry which seems to have the greatest promise for the future is that of the explanation of the physiological activity of chemical substances. Little success has resulted from the efforts of chemists and physiologists to correlate the physiological properties of substances and their ordinary chemical properties—the properties which depend upon breaking the chemical bonds within molecules and forming new chemical bonds.

As our knowledge of the structure not only of simple molecules but also of proteins and other complex constituents of organisms increases, we shall in time achieve an insight into physiological phenomena which will serve as an effective guide in biological and medical research.

Linus Pauling, Willard Gibbs Medallist, before Chicago Section, American Chemical Society, June 14, 1946.

FOREIGN LITERATURE ABSTRACTS

CORROSION OF ALUMINUM

ELECTROCHEMICAL study of the decomposition of solid solutions of aluminum show that the rate of corrosion does not depend so much on the nature of the heterogeneity but rather on its crystalline and electrochemical nature. The principle of electrochemical homogeneity or of equipotential surface should therefore be added to that of structural homogeneity, a factor of good resistance to corrosion. Study of the thermal decomposition of a solid aluminum-magnesium solution leads to the conclusion that the anomoly toward 280 deg. heat which is observed on the conductivity curves, as on the dilatometric curves, cannot be attributed to a change of state corresponding to an equilibrium diagram. The absence of reversibility and the disappearance of that anomoly leads to the hypothesis of an intermediate unstable precipitated phase incapable of existing above a temperature of 280 deg.

The mechanism of the decomposition of solid solutions can be summed up schematically by defining the different reaction stages as follows: unbalanced solid solution, balanced solid solution, intermediate phase oriented in relation to the solid solution, stable equilibrium phase more or less related to the multiple orientation with respect to the intermediate phase. The term structural hardness, properly speaking, is reserved for that which accompanies the phenomena prior to precipitation, in contrast to ordinary hardening due solely to the precipitated phase. With application of heat, the precipitation of a second phase is accompanied by another increase in the hard-

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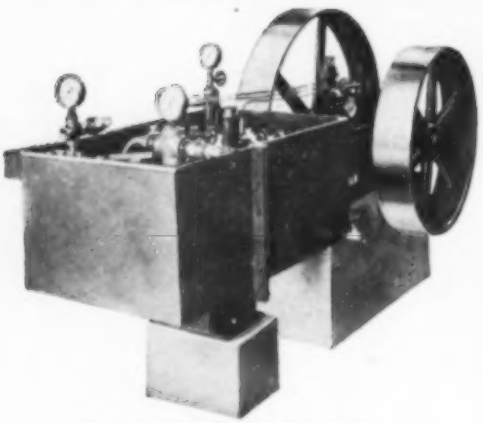

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ness of the breaking load and even of the elastic limit.

Digest from "Physico-Chemical Study of the Decomposition of Some Solid Solutions of Aluminum," by P. Lacombe, *Rev. Metallurgie* **41**, Nos. 6–8, 180–187, 217–226, 259–272, 1944. (Published in France); *Chimie et Industrie* **55**, No. 3, 203–204 1946.

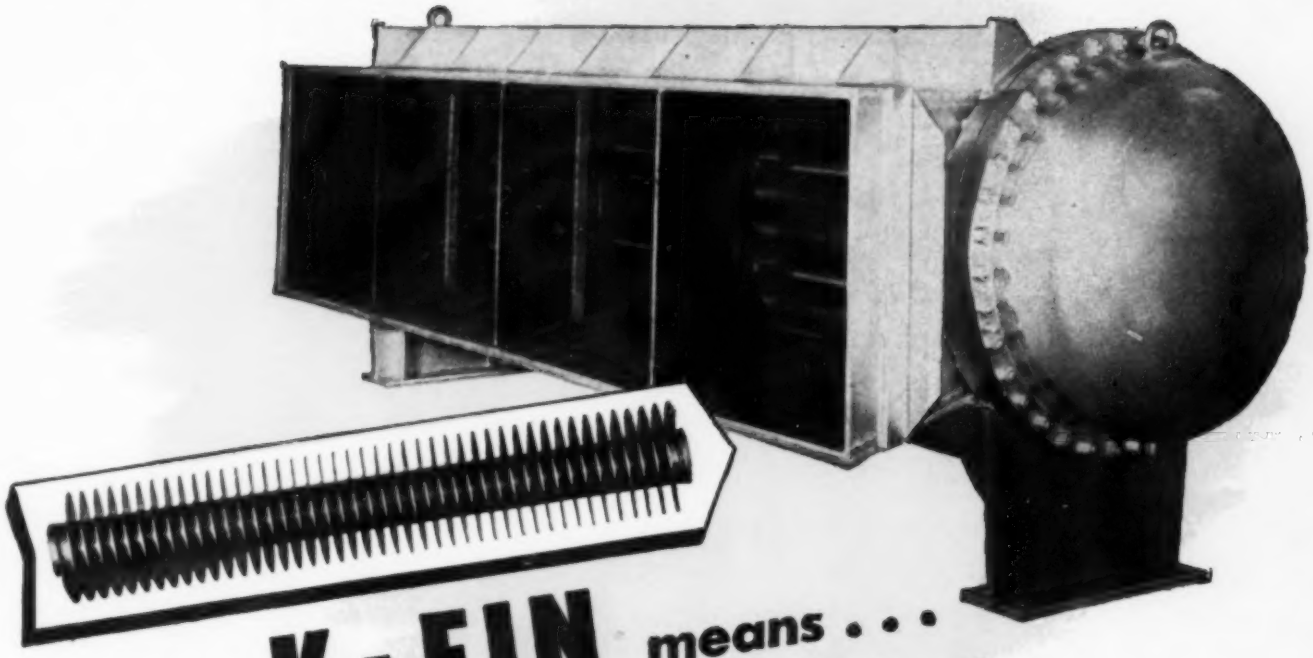
HYDROCARBON DEHYDROGENATION WITH VANADIUM CATALYST

Dehydrogenation of cyclohexane and methyl cyclohexane with vanadium catalyst within the temperature range of 440-550 deg. C. was investigated and it was shown that in this reaction cyclohexane is converted to benzene and cyclohexene simultaneously. The latter was separated from the products of catalysis in the form of its compound with mercuric chloride. Six-membered cycloalkanes can also be dehydrogenated to aromatics and cycloolefins in the presence of alumina-chromia. The cyclohexane conversion yields pure hydrogen, unlike the dehydrogenation of *n*-heptane. The total reaction of dehydrogenation of cyclohexane and methyl cyclohexane and the separate reactions leading to olefins and aromatics, respectively, proceed according to the Arrhenius equations. The energies of activation are 39,800 and 34,700 cal. per mol for cyclohexane and methyl cyclohexane, respectively, in the dehydrogenation of both the cyclohexanes and indicate that six-membered cyclohexanes are dehydrogenated more easily than paraffins. There is greater similarity in the formation of olefins from hydrocarbons of different classes and different molecular weights than between formation of olefins and aromatics from the same hydrocarbon. No carbon was formed on the vanadium catalyst in the hydrogenation of the six-member ring compounds, which was not the case with *n* heptane and especially ethyl cyclopentane. The clean surface of the catalyst was considered to be responsible for high adsorption capacity with respect to cyclohexane and hydrogen. It was shown that most of the benzene formed results from direct conversion of cyclohexane, only a part of the latter being converted to cyclohexene. These two reactions are believed to occur on different active centers of the vanadium catalyst. A fraction of cyclohexene undergoes further conversions and also produces benzene. This mechanism is in agreement with that of Balandin et al, although in the dehydrogenation of cyclohexane on a chromia catalyst these investigators favor the doublet scheme (edge orientation) with subsequent formation of cyclohexene, cyclohexadiene and finally benzene.

Digest from "Mechanism of Contact Conversions of Hydrocarbons on a Vanadium Catalyst. IV. Dehydrogenation of 6-Membered Rings," by A. F. Plate and G. A. Tarasov, *Zhurnal Obschei Khimii* **15**, 120–130, 1945. (Published in Russia.)

DETERMINATION OF OCTANE NUMBER

High octane number of oils used as motor fuel is a linear function of the ketene number which is related to ignition delay D by the hyperbolic relation $C(D—C)=K$, C being the ketene number, L and K the constants for the given experimental conditions. In order to get results comparable to those obtained in a motor, the fuel must be



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subjected to the same oxidation reactions in the chamber as in the motor, in particular with regard to turbulence and hot points, the influence of which is fundamental. This is attained by using a uniformly heated toroid chamber containing a diesel motor igniter which serves as the hot point of the exhaust valve. The fuel is introduced tangentially by a jet of compressed air by a device similar to a diesel motor point. The rising of the injection point closes an electric circuit which is opened by a device senstive to degree of pressure, and the ignition delay can thus be measured. Once the apparatus is standardized, the octane number of the fuel under consideration can be deduced. The conditions of operation of any motor whatsoever can be reproduced by acting on the different parameters.

Digest from "Determination of Octane Number," by J. Dumanois, *C.R. Acad. Sc.* **219**, Nos. 1-5, 154-155, 1944. (Published in France); *Chimie et Industrie* **53**, No. 1, 35, 1945.

ADHESIVES FROM VINYL ETHINYL CARBINOLS

Vinyl ethinyl carbinols which have been partially polymerized to a viscous sirupy state have exceptionally good adhesive properties and, on further polymerization, are capable of gluing metals, plastics, marble, porcelain, glass, mica, minerals, ebonite, fiber, wood pulp and other materials to themselves or to one another. Addition of 20-30 percent chloroprene to the carbinol makes it possible to glue rubber to metal and other materials listed above. The attached table gives the resistance to cleavage of some of the materials glued with the carbinol adhesive. The adhesive is a solution of intermediate, low-molecular polymers in monomeric carbinol with a polymer content of 10 to 20 percent, depending on the viscosity of the adhesive. Final polymerization of the carbinol adhesive takes place between the surfaces of the materials being glued until a high-molecular, vitreous polymer is formed. The carbinol adhesive is prepared by heating the monomeric, unstabilized carbinol at 60-65 deg. in a metallic, or better still, glass container for 20-25 hr. Heating time can be reduced to 5-10 hr. if 0.05-0.1 percent benzoyl peroxide is dissolved in the carbinol before polymerization. The carbinol adhesive thus prepared is stabilized by a solution of 0.25 percent agerite. The stabilized carbinol adhesive can be stored in a dark, cool place for about 6 mo. This glue hardens (polymerizes) in 24 hr. at 20-25 deg., in 10-12 hr. at 40-45 deg., in 6-8 hr. at 60-65 deg.

Digest from "Chemistry of Vinyl Ethinyl Carbinols," by I. N. Nazarov, *Uspekhi Khimii* **XIV**, No. 1, 3-41, 1945. (Published in Russia.)

Specific Resistance to Cleavage by Materials Joined with Carbinol Adhesive

Materials	Kg. per Sq.Cm.
Steel—steel	250–300
Dural—dural	250–300
Steel—dural	200–300
Textolite—textolite	125–200
Porcelain—porcelain	150–200
Marble—marble	150–200
Glass—glass	120–150
Fiber—fiber	90–120
Ebonite—ebonite	100–150
Dural—textolite	130–190
Dural—balinite	150–200
Dural—delta .metal	150–200
Dural—fiber	100–115
Dural—ash (wood)	100–150

CHEMICAL ENGINEER'S BOOKSHELF

LESTER B. POPE, Assistant Editor

AUTOMATIC CONTROL

INSTRUMENTS AND PROCESS CONTROL. *The New York State Vocational and Practical Arts Association. Delmar Publishers, Inc., 49 Sheridan Ave., Albany, N. Y. 233 pages. $2.75.*

DEVOTED primarily to the operation and use of pneumatic control instruments, this 8½ in. x 11 in. plastic bound book was prepared for publication in the curriculum laboratory at Cornell University in cooperation with the Taylor Instrument Cos., Rochester, N. Y. It consists, to some extent, of a compilation of material which has previously appeared in bulletins and catalogs of various instrument manufacturers. It is well illustrated with some 200 schematic diagrams, line drawings, and photographs.

Important elements of a pneumatic control system are defined and the operating principles of various pneumatic mechanisms are illustrated and described so that the functions of each device may be understood readily. No particular effort is made to cover measuring devices except in a general way. Basic control theory is discussed under the headings of on-off response, proportional response, proportional plus reset response, and proportional plus rate response. Methods and mechanisms for obtaining the various control effects are described in some detail. One chapter describes the major types of control valves and gives construction and operating details. Considerable data on valve selection are included; several nomographs or valve selector charts as well as a valve selector slide rule are illustrated. Characteristics of various types of valves are discussed and graphically illustrated.

A considerable portion of the book is devoted to industrial controller applications. This covers a wide range of typical applications in various process industries including food, textile, petroleum, pulp and paper, etc. Here, too, the use of various specialized forms of pneumatic controllers are discussed. These include remote pneumatic transmission, ratio control, time schedule control, and pneumatic set control. Rather extensive chapters are given over to the discussion of automatic control of fractionating columns, heat exchangers, and industrial air conditioning systems.

Practical information on installation of control systems, controller adjustments, and checking and testing procedure is given. Finally, the appendix includes an extensive glossary of terms and a section entitled Advanced Control Theory.

Principal limitations of this book are that it deals only with pneumatic controllers and that it is not concerned with measuring devices nor with electric, electronic, and hydraulic systems.

LECTURES ON EMULSIONS

INTRODUCTION TO EMULSIONS. *By George M. Sutheim. Chemical Publishing Co., Brooklyn. 260 pages. $4.75.*

SEVERAL lectures on emulsions were given at Brooklyn Polytechnic Institute by the author of this book. Apparently what he did subsequently was to collect his lecture notes and have them published verbatim for the book abounds with such phrases as "I put in a jar some water (sic) and . . . kerosene. Now I shake the liquids violently (Experiment 1)"; "I want to show you another experiment"; "We stated before. . ."; "You remember . . ."; and "As you know. . ." But this is merely mildly irritating. Once the reader becomes inured to being addressed personally he will find the theoretical aspects of the whole subject of emulsions are well covered. Theory, chemistry and physical chemistry are discussed as well as the formation and properties of emulsions. The sixth chapter deals with some applications in fields such as adhesives, cosmetics, detergents, food, latex, leather, and paint. The book concludes with a glossary, a list of emulsifying agents, bibliography and an adequate index.

MICROPROCEDURES

QUANTITATIVE ORGANIC MICROANALYSIS. *Fourth English edition. Revised and edited by Julius Grant. The Blakiston Co., Philadelphia. 238 pages. $5.*

Reviewed by A. I. Gebhart

THIS revision of the pioneer work of Pregl is a worthwhile addition to the literature of organic microanalysis. The increased scope of the work covers many of the important quantitative microprocedures which are brought up to date by approximately 350 literature references. The book is nicely printed on good paper, making for easy reading, however a few typographical errors are present and the general format could be subject to some improvement.

It seems unfortunate that an effort appears to have been made to limit the size of the text to that of the earlier editions. In view of the considerable increase in the number of procedures discussed this has resulted in some lack of detail in certain instances, however the bibliography compensates for this to a considerable extent. No mention has been made of the useful and important determination of the saponification equivalent of esters nor of the rapid, and generally satisfactory, peroxide bomb procedure for sulphur and halogens. The alkoxyl determination has been recently extended to include higher ethers such as propyl and butyl but no reference to the procedure is given. It seems that some of the special sections dealing briefly with chromatography, absorption spectroscopy, polarography, and the like might better have been left to texts specializing in the field and the space devoted more profitably to greater detail in the major topics.

Nevertheless it is felt that this book is a definite contribution in its field and will be found useful both by the novice as well as the more experienced microanalyst.

RECENT BOOKS RECEIVED

The Chemical Aspects of Light. 2nd ed. By E. J. Bowen. Oxford. $5.

Government Statistics for Business Use. Ed by P. M. Hauser and W. R. Leonard. Wiley. $5.

Modern Organic Finishes. By R. H. Wampler. Chemical. $8.50.

Textbook of Physical Chemistry. 2nd ed. By S. Glasstone. Van Nostrand. $12.

Two Worlds. By W. B. Ziff. Harper. $3.

Water Treatment and Purification. 2nd ed. By W. J. Ryan. McGraw-Hill. $2.75.

A REPRINT

KINGZETT'S CHEMICAL ENCYCLOPAEDIA. *Seventh edition. Edited by Ralph K. Strong. D. Van Nostrand Co., New York. 1,092 pages. $16.*

ON THESE pages in May, attention of *Chem. & Met.* readers was called to another reference reprinted and available at a reduction in price. In the case of Kingzett's, the reprinting is called a new edition and costs more. Changes made between the sixth and seventh editions hardly seem to justify the increase, especially when, with few exceptions, the same type appears to have been used for both. The new printing has four pages more than its predecessor because the article on vitamins has been rewritten and expanded.

Other changes include short additions to several entries such as sodium chlorite, standard specifications, sulfa compounds, paper and wood. Additional references have been added in a few cases, e. g.: explosives, organic analysis and silver. Some spellings have been changed; Frairy, protoactinium and pysllium are now Frary, protactinium and psyllium. The brief list of newcomers includes atabrine, fluoborates, fritted glass, penicillin, phenothiazine. Space was made for additions by dropping and shortening other entries.

The encyclopedia contains about three dozen tables of commodity import, export, consumption or production data for the year 1936. Many of these 10-year-old statistics could have been modernized a bit even if the war did intervene. Other changes could have been made. For example, the synthetic rubber industry did not affect the revision—the definitions of styrene (used in

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medicine and perfumery) and butadiene are unchanged, neoprene is called duprene, silicones are absent as are guayule, buna-S and all the GR rubbers.

It is probable that, when time and paper are more available, a new edition of this British reference will be forthcoming and that some of the shortcomings of this one will be eliminated.

For comments on the book's contents the reader is referred to the review of the sixth edition (*Chem. & Met.*, Oct. 1940, p. 725).

RECENT BOOKS and PAMPHLETS

A Manual for Explosives Laboratories. Vol. IV. By B. T. Fedoroff, G. D. Clift and D. C. McLean. Published by Lefax Publishers, Philadelphia 7, Pa. 148 pages. Addenda and errata for Vols. II and III of the Lefax explosives manual.

Chemical Safety Data Sheet—Benzene. Published by Manufacturing Chemists' Association, 608 Woodward Bldg., Washington 5, D. C., 16 pages. 25 cents. Physical and chemical properties, hazardous characteristics, containers, handling, storage, labels, protective equipment, medical controls and first aid.

Testing Plastics Parts. Published by The Society of the Plastics Industry, 295 Madison Ave., New York 17, N. Y. 14 pages. A preprinted chapter from the forthcoming SPI handbook. Methods of testing.

Syrups and Syrup Making. Published by American Bottlers of Carbonated Beverages, 1128 Sixteenth St., Washington 6, D. C. 37 pages. Mimeographed textbook chapter for an ABCB short training course in beverage production and plant operation.

The Development, Properties and Fabrication of Fiberglas-Reinforced Plastics. By G. Slayter and H. W. Collins, Owens-Corning Fiberglas Corp., Toledo 1, Ohio. 13 pages. Paper presented at 38th annual meeting of the American Institute of Chemical Engineers in Chicago.

A.S.T.M. Standards on Rubber Products. Published by American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa. 540 pages. $3.25. Enlarged 1946 edition of test methods and specifications.

Rheology of Surface Coatings. Edited by Stewart Hoagland. Published by R-B-H Dispersions, Inc., Bound Brook, N. J. 80 pages. A small reference book of the measurement of flow properties, particularly as applied to paints and pigments. Includes a glossary and bibliography.

X-Rays in Practice. By W. T. Sproull. Published by McGraw-Hill Book Co., New York 18, N. Y. 615 pages. $6. History, tubes, spectra, protection, industrial and analytical applications.

Your Stake in Collective Bargaining. By T. R. Carskadon and S. T. Williamson. Pamphlet No. 117, published by Public Affairs Committee, 30 Rockefeller Plaza, New York 20, N. Y. 32 pages.. 10 cents. The constructive value of collective bargaining for the general public as well as for employers and workers.

Le Zinc et Ses Alliages. By R. Grunberg, M. Marechal, H. Patin and E. Wagner. Published by Dunod, 92 Rue Bonaparte, Paris (VI). 233 pages. 500 fr. Metallurgy, characteristics and uses, sheet zinc, alloys, die casting, corrosion of zinc and alloys, alloy analysis. Written in French.

Textbook of Biochemistry. By P. H. Mitchell. Published by McGraw-Hill Book Co., New York 18, N. Y. 640 pages. $5. Carbohydrates, fats, proteins, vitamins, enzymes, metabolism dietetics, hormones, chemotherapy, etc.

Industrial Research, 1946. Edited by E. N. daC. Andrade. Published by Todd Publishing Co., New York 5, N. Y. 736 pages. $6. Articles of research interest in all industries. A British publication also listing official directories, official and unofficial statements, officially-appointed committees, directories, laboratories, books and who's who.

The Economics of the Potash Industry. By Jules Backman. A report prepared for and published by The American Potash Institute. 1155-16th Street, N. W., Washington 6, D. C. Gratis. A resume of supply, demand, price, cost, and in-

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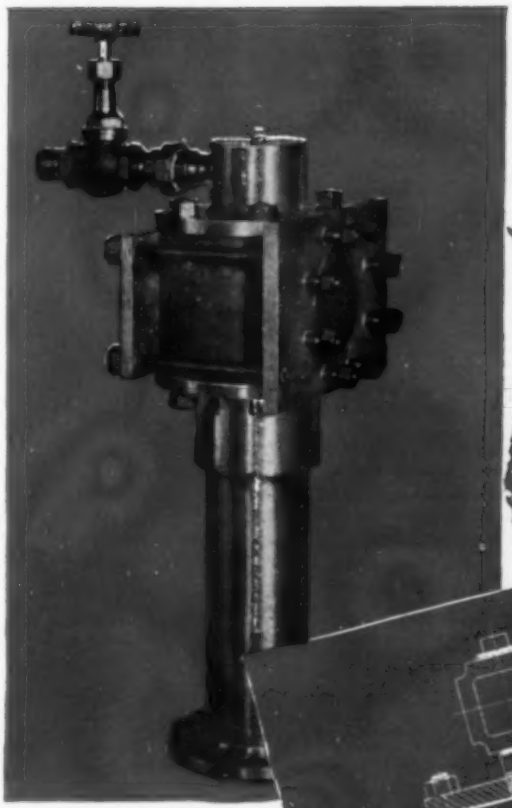

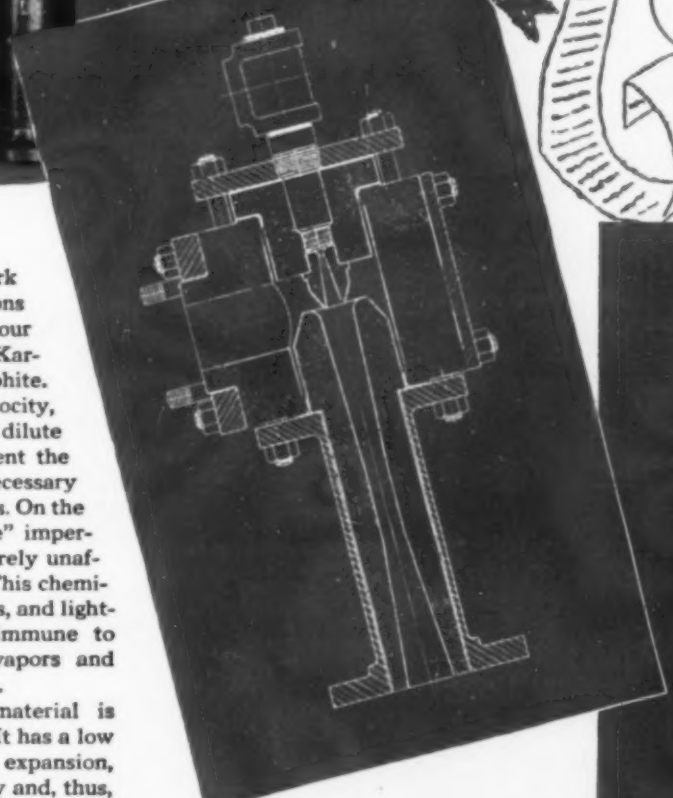

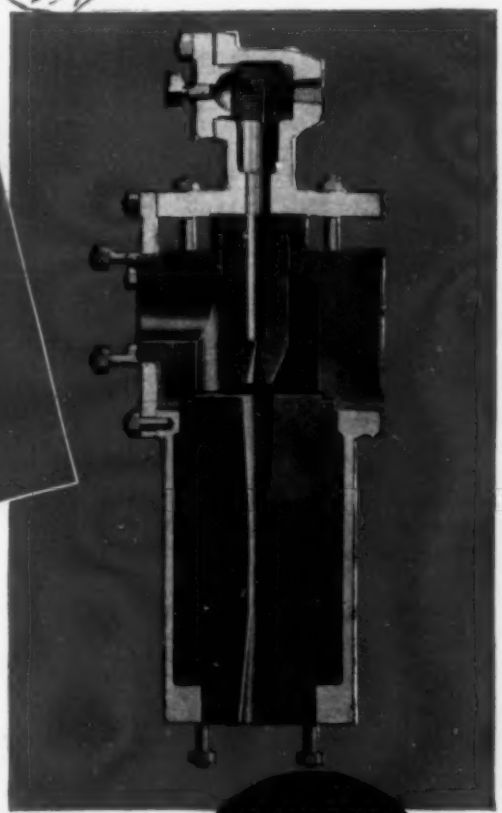

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The Metallurgy of Steel Castings. By C. W. Briggs. Published by McGraw-Hill Book Co. New York 18, N. Y. 633 pages. $6.50. A complete reference on technical and metallurgical control of all manufacturing operations that enter into the production of steel castings.

Gas in Light Alloys. By L. W. Eastwood. Published by John Wiley & Sons, New York 16, N. Y. 99 pages. $2.50. Cause, effect, and cure of gas absorption in light alloys by the assistant supervisor of Battelle Memorial Institute's Division of process metallurgy.

Tinplate. By W. E. Hoare and E. S. Hedges. Published by Edward Arnold and Co., London. (Available in this country from Longmans, Green and Co., 55 Fifth Ave., New York.) 292 pages. $12. Two officers of the Tin Research Institute give history, manufacture, uses, properties structure, testing methods, corrosion resistance, production statistics and nearly 400 references.

Pacific Northwest Chemical & Metallurgical Industries. Published by Industrial Dept., Portland Chamber of Commerce, Portland 4, Ore. 5 pages. A mimeographed list, classified by products, of names and locations of chemical, metallurgical and certain chemical process manufacturing firms in the Pacific Northwest, including British Columbia.

Plastics Industry of Los Angeles County. Published by Industrial Dept., Los Angeles Chamber of Commerce, 1151 South Broadway, Los Angeles, Calif. 23 pages. A mimeographed list of manufacturers in the plastics industry, classified by raw materials; phenolic casting; coatings; acrylic and acetate fabrication, extrusion, compression and injection molding; and lamination. Also contains a brief survey of opportunities for industrial development in this industry in the region.

GOVERNMENT PUBLICATIONS

The following recently issued publications are available at prices indicated from the Superintendent of Documents, Government Printing Office, Washington 25, D. C. In ordering any publications noted in this list always give complete title and the issuing office. Remittances should be made by postal money order, coupons or check. Do not send postage stamps. All publications are in paper cover unless otherwise specified. When no price is indicated, the pamphlet is free and should be ordered from the Bureau responsible for its issue.

Lubricants and Liquid-Fuels; Federal Specification for Lubricants and Liquid-Fuels. Federal Standard Stock Catalog, Section IV, Part 5, VV-L-791c. Price 75 cents.

Federal Specifications Index. Federal Standard Stock Catalog, Section IV, Part 1. Revised to Feb. 1, 1946. Price 30 cents.

Some Books and Pamphlets on Paints, Painting, and Wood Finishing. Forest Products Laboratory, Madison, Wis. Technical Note No. 195. Processed.

Bolt-Bearing Strength of Wood and Modified Wood. By P. J. Hunt, H. R. Goodell, and R. S. Phillips. Forest Products Laboratory, Madison, Wis. No. 1523-B. Processed.

List of Publications Relating to Fungus Defects in Forest Products and to Decay in Trees. Forest Products Laboratory, Madison, Wis. No. R508. Processed.

Summary of Investigators Reports on Technical Industrial Forest Products Developments in Germany. By Carlile P. Winslow and Donald G. Coleman. Forest Products Laboratory, Madison, Wis. Unnumbered. Processed.

DDT, Its Effect on Fish and Wildlife. Fish and Wildlife Service, Circular 11. Price 5 cents.

Imports of Coal-Tar Products 1945. U. S. Tariff Commission. Unnumbered. Processed.

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CLEANING AND CORROSION TIPS

Issue No. 3

JULY 1946

IT'S THE CLEANING PROCESS THAT COUNTS

You and I know a fellow may be well dressed—but he can't walk very far if his shoes don't fit.

Similarly, any good chemical cleaning material is limited by the manner in which it is used. I'm referring not only to the equipment itself, but, more specifically to the sequence of operations—the cycle, if you will, and the conditions in each step in the cycle.

The cleaning *cycle* is a *team* of operations working together to remove the obstacle, the soil, and to prepare the way for subsequent finishing operations.

Just as a powerful fullback may be thrown for a loss if an end misses his block—so a good cleaner will fail if its "blockers"—equipment, temperature, time, current, rinsing, etc., are inadequate. Thus, our sales servicemen are trained to think of the "Cleaning Process," rather than just the cleaner itself.

Wm. P. Drake
Manager of Sales
Pennsylvania Salt Manufacturing Co.

CASE NO. 704

Heat Treating, Quenching, and Cleaning Cycle Speed Increased 100%

A machine tool manufacturer had a rack conveyorized cycle of heat treating, quenching and cleaning for steel tool parts. The metallurgist was on the spot because the cleaning of oily salts from the parts was slowing up the whole process. He called on a Pennsalt man for help. After a complete investigation of the cycle, he recommended Pennsalt Cleaner No. 37. This quick acting, heavy duty cleaner cut the cleaning time in half . . . without increasing the number or size of the tanks.

This proved to be even faster than necessary for the heat treating and quenching phases of the cycle. Then a new method of racking the work was designed by the Pennsalt man and the metallurgist for maximum production efficiency of the conveyor system. Now heat treating, quenching and cleaning speed is up 100%—production costs are much lower.

CASE NO. 751

Large Motor Manufacturer Eliminates Bonderite Streaking

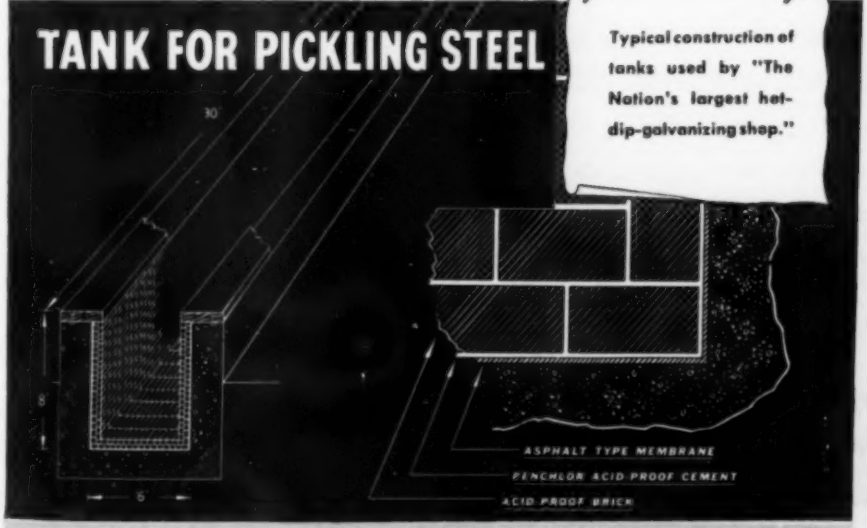
Cleaning equipment down-time cut from 5 hours to 25 minutes weekly

An all-automatic conveyorized system was being used to clean, bonderize, and paint sheet steel parts. In spite of the efficient equipment, the cleaning foreman was plagued by streaks on the bonderizing and subsequent poor paint finish. In addition, down-time for changing the screens in the cleaning tank was stopping production 5 hours weekly.

The Pennsalt man called in to solve this tough problem saw that major changes were needed in the cleaning operation. He recommended a solvent-alkali cleaning method consisting of Pennsalt #30 (Alkaline Cleaner) and Pennsalt EC #10 (Solvent Emulsion Cleaner), both of which could be used in the regular equipment. Production shut downs, due to clogged screens were practically eliminated. Bonderite streaking disappeared. The paint foreman reported, "We have never had a better paint job."

TANK FOR PICKLING STEEL

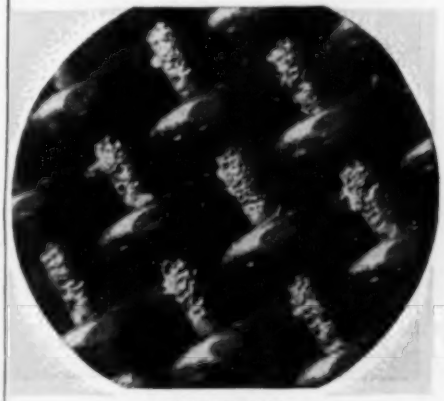
Typical construction of tanks used by "The Nation's largest hot-dip-galvanizing shop."



Tank lined with double course acid-brick, laid entirely with Penchlor Acid-Proof Cement, which gives thorough protection against severe corrosive action of 10% sulphuric acid at 180° F. and withstands the physical abuse resulting from submerging and withdrawing steel plates.

THE LAB NOTEBOOK

Frequently it is necessary to develop cleaning methods for customers wherein the metal must be chemically clean and not attacked by the cleaner. To determine if there is an attack and the amount of it, photomicrography is used. The photomicrograph of a fine copper wire screen shown below has been especially prepared (purposely etched) to indicate how even infinitesimal etching of metals by the cleaner can be detected. This is but one of the many methods employed by the Pennsalt Whitemarsh Research Laboratories in a continuing effort to develop better cleaning processes.



CASE NO. 769

Cleaning Foreman Helps Plant Engineer Lick Water Scale Problem

In a large industrial plant the heat exchanger of an air conditioning unit frequently lost its efficiency and required dismantling to remove hard water scale. Two to three days were required to remove the scale by manual chipping. At best, only a fair job could be done.

Because of the cleaning foreman's experience with cleaning metal chemically, the plant engineer asked for his advice on the problem. "Let's put it up to the Pennsalt man," suggested the cleaning foreman. Subsequently, Pennsalt PM-90 was put to the test. In less than 3 hours the metal of the heat exchanger was bright and clean, absolutely free of its heavy deposit of scale.

Pennsalt PM-90 is an acid-type chemical cleaner. It can be used warm or cold, concentrated or diluted to remove rust, corrosion and scale deposits. Can be used safely on iron, steel, copper, brass, bronze, nickel, and their principal alloys.

The Pennsalt Man is trained to help you produce better cleaned products at a faster rate and at lower cost. If you would like to see him, write to Dept. CM-7. If your problem is urgent—wire, and he will call immediately.

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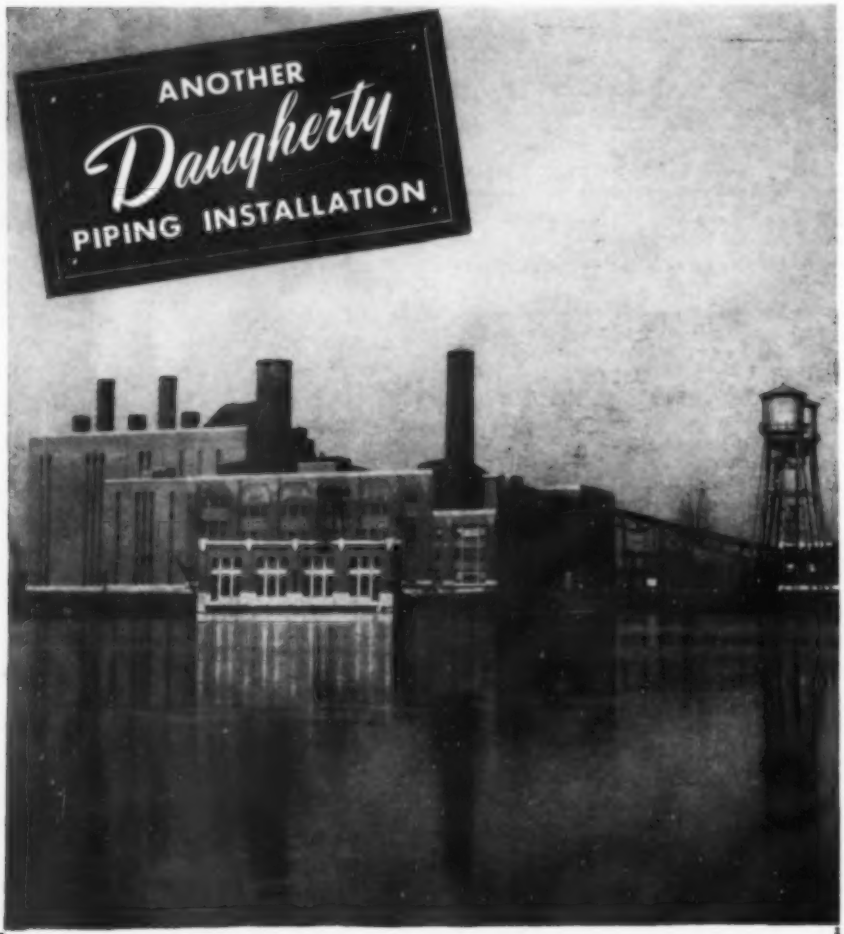

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in Industry Series, Report No. 17. Price 30 cents.

Recent Developments in the Foreign Trade of Colombia. Tariff Commission. Unnumbered. Price 15 cents.

Economic Controls and Commercial Policy in Cuba. Tariff Commission. Unnumbered. Price 15 cents.

Economic Controls and Commercial Policy in the Dominican Republic. Tariff Commission. Unnumbered. Price 10 cents.

Economic Controls and Commercial Policy in Haiti. Tariff Commission. Unnumbered. Price 10 cents.

Methyl Bromide as a Delousing Agent. By Randall Latta, Henry H. Richardson, and James B. Kindler. Department of Agriculture, Circular No. 745. Price 10 cents.

Relation of Soil Reaction to Toxicity and Persistence of Some Herbicides in Greenhouse Plots. By Annie M. Hurd-Karrer. Department of Agriculture, Technical Bulletin No. 911. Price 10 cents.

Canker Stain of Planetrees. By James M. Walter. Department of Agriculture, Circular No. 742. Price 5 cents.

Safety Subjects. Department of Labor, Labor Standards Division, Bulletin No. 67. A training manual for factory inspectors. Price 20 cents.

Report on the Industrial Disarmament of Japan. Mimeographed report submitted to the Secretaries of State, War, and Navy by The National Engineers Committee of Engineers Joint Council. Available from Public Relations Division, War Department.

Analyses of Alaska Coals. Bureau of Mines, Technical Paper 682. Price 25 cents.

Production of Lithium Chloride from Spodumene by a Lime-Gypsum Roast Process. By W. M. Sternberg, Earl T. Hayes, and F. P. Williams. Bureau of Mines, Report of Investigations R. I. 3848. Mimeographed.

Pilot-Plant Production of Electrolytic Manganese from Chamberlain, S. Dak., Nodules. By J. H. Jacobs and J. W. Hunter. Bureau of Mines, Report of Investigations R. I. 3862. Mimeographed.

Recovery of Cobalt from Manganese Ores in the Production of Electrolytic Manganese. By David Schlain, J. H. Jacobs, F. K. Shelton, and R. G. Knickerbocker. Bureau of Mines, Report of Investigations R. I. 3866. Mimeographed.

Report of the Investigation of the Fire at the Liquefaction, Storage, and Regasification Plant of the East Ohio Gas Co., Cleveland, Ohio, October 20, 1944. By M. A. Elliott, C. W. Seibel, F. W. Brown, R. T. Artz, and L. B. Berger. Bureau of Mines, Report of Investigations R. I. 3867. Mimeographed.

Extinction of Gasoline Flames by Inert Gases. By G. W. Jones and W. R. Gilliland. Bureau of Mines, Report of Investigations R. I. 3871. Mimeographed.

Physical and Combustion Characteristics of Packaged Fuel Containing Anthracite Fines. By L. D. Schmidt, W. T. Reid, William Seymour, and J. W. Myers. Bureau of Mines, Report of Investigations R. I. 3882. Mimeographed.

Exploration of Red Mountain Chromite Deposits, Kenai Peninsula, Alaska. By F. A. Rutledge. Bureau of Mines, Report of Investigations R. I. 3885. Mimeographed.

The Properties and Uses of Helium (Including a Comprehensive Bibliography, 1933-45). By Henry P. Wheeler, Jr. Bureau of Mines, Information Circular I. C. 7344. Mimeographed.

Mining and Marketing of Barite. By Charles L. Harness and F. M. Barsigian. Bureau of Mines, Information Circular I. C. 7345. Mimeographed.

Annual Report of Research and Technologic Work on Coal. Fiscal Year 1945. By A. C. Fieldner and R. E. Brewer. Bureau of Mines, Information Circular I. C. 7352. Mimeographed.

Economic Concentration and World War II. Report of the Smaller War Plants Corporation to the Special Committee to Study Problems of American Small Business. Senate Committee Print No. 6. Price 50 cents.

Annual Report of the Tennessee Valley Authority for the Fiscal Year Ended June 30, 1945. Price 50 cents.

Survey of Tin in California. By R. H. Bedford and F. T. Johnson. Bureau of Mines, Report of Investigations R. I. 3876. Mimeographed.

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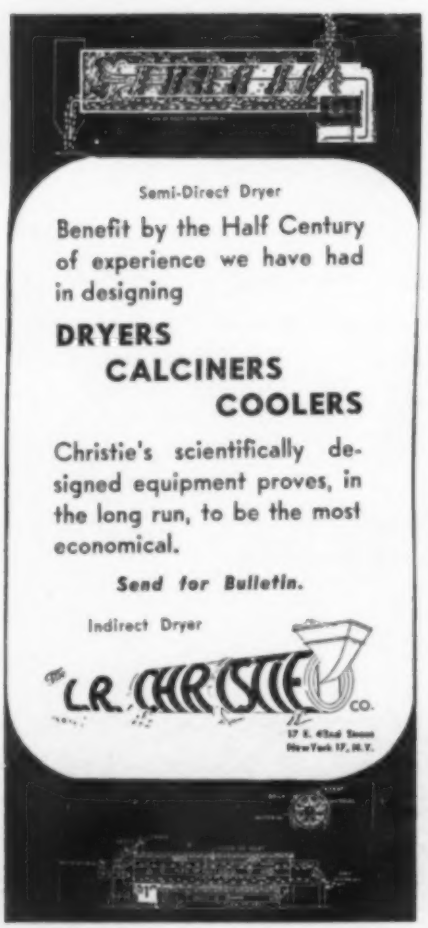

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1

Alcohol. Shell Chemical Corp., San Francisco, Calif.—Booklet SC:46-1. 38-page plastic bound book describing methyl isobutyl carbinol (methyl amyl alcohol). Discusses the use of this material in various types of coatings and discusses the basic physical characteristics which are generally considered in the evaluation of a solvent for use in lacquer formulation. Contains a list of physical properties as well as specifications of the commercial product.

2

Alloys. Ampco Metal, Inc., Milwaukee, Wis.—Bulletin 66. 12-page booklet illustrating and describing the machining of Ampco metal and aluminum bronze and alloys. Bulletin 81. 4-page leaflet describes and illustrates Ampcoloy 90 which is claimed to have a minimum electrical conductivity of 90 percent. Bulletin 117. 28-page catalog illustrating and describing safety tools made by this company. Includes price list. Also a classification chart of bronze electrodes and grade numbers of arc-welding rods produced by various manufacturers.

3

Boilers. John Phillips Badenhausen, Inc., Philadelphia, Pa.—4-page leaflet featuring this company's circulatory system for increasing steam capacities in existing boilers.

4

Boilers. Combustion Engineering Co., Inc., New York, N. Y.—Catalog No. GC-10. 12-page condensed catalog of equipment for stationary power plants, designed and manufactured by this company. Includes information on stokers, burners, superheaters, economizers, etc.

5

Chemicals. Carbide and Carbon Chemicals Corp., New York, N. Y.—Three new booklets are available from this company on certain chemical products. The first entitled "Columbia Activated Carbon" described the use of activated carbon for solvent recovery, purification of air or gas, or as a catalyst carrier. Specifications as well as suggested applications are described. Form 4712. The booklet entitled "Anhydrides" discusses in detail the properties and uses of acetic anhydride, propionic anhydride, butyric anhydride, and maleic anhydride. Contains charts with data on vapor pressures, specific gravities, viscosities and other physical and chemical properties of these compounds. Form 5280. A third booklet entitled "Aldehydes" gives the properties and specifications of butyraldehyde, ethylbutyraldehyde, ethylhexaldehyde, ethylpropylacrolein, and glyoxal. Form 5278.

6

Chemicals. Witco Chemical Co., New York, N. Y.—198-page book cataloging the chemical products of this company. Included is information on carbon black, colors, white pigments, extenders, asphalt materials, waxes, and other chemicals. Also contains information on properties, specifications, applications, and other technical data relating to these chemical products.

7

Cleaning Agent. Pennsylvania Salt Mfg. Co., Philadelphia, Pa.—A pamphlet on the use of Pennsalt PM-9, a new acid type chemical cleaner for metals.

8

Colloidal Graphite. Acheson Colloids Corp., Port Huron, Mich.—4-page leaflet featuring the control of static electricity on belts with DAG colloidal graphites.

9

Desuperheaters. Elliott Co., Jeannette, Pa.—Bulletin C-1. 4-page leaflet featuring the cartridge type desuperheaters manufactured by this company. Operation is described for total or partial desuperheating. Includes data on automatic temperature control of desuperheaters, together with a diagrammatic sketch showing a typical arrangement of desuperheater application.

10

Detergents. Pennsylvania Salt Mfg. Co., Philadelphia, Pa.—4-page leaflet describing the use of Pensal-B for use in laundries.

11

Draft Controls. Campbell Engineering Co., Appleton, Wis.—16-page illustrated booklet entitled "How to Cut Your Fuel Bill" describes the different models of electric draft controls manufactured by this company. Data are included on how these controls operate with stokers, oil and gas burners.

12

Electrical Equipment. General Control Co., Boston, Mass.—12-page illustrated booklet de-

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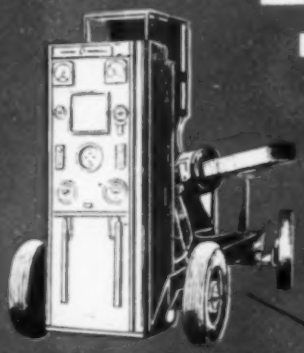

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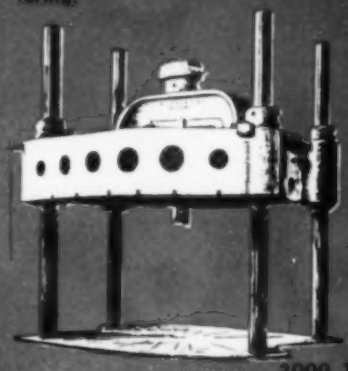

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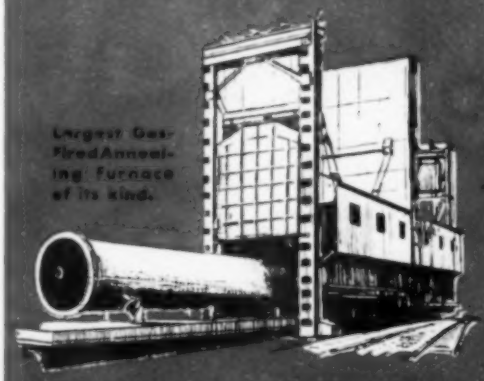

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13

Electrical Relays. Leach Relay Co., Los Angeles, Calif.—48-page catalog listing the relays manufactured by this company. Includes engineering details, and shows contact arrangement, coil voltages available, dimensions and weights for each type of relay.

14

Electric Motors. General Electric Co., Schenectady, N. Y.—Bulletin GEA 4443. 8-page bulletin describing and illustrating the capacitor-motors for jet pump drives. Includes data on construction, operation and application.

15

Electroplating Controls. Columbia Electric Mfg. Co., Cleveland, Ohio.—4-page illustrated folder describing the cast-grid type tank-rheostat for electroplating control.

16

Exhaust System. B. F. Sturtevant Co., Inc., Hyde Park, Boston, Mass.—Catalog No. 430-3. 24-page catalog gives uses, construction and sizes of exhaust fans designed for dust control, fume exhaust, and collecting and conveying materials which can be carried on a current of air. Includes performance tables together with dimension diagrams and illustrations of the various equipment.

17

Furfural Chemicals. Quaker Oats Co., Chicago, Ill.—Bulletin 202. 16-page booklet entitled "Introduction to the Chemistry of Furans" covering in some detail the structural formulas, nomenclature, chemical properties and formation of these compounds. Describes methods of detection and analysis and contains charts showing principal reactions of furfural. Bulletin 203. 16-page booklet entitled "Physical Data on Furfural" contains a large number of tables and graphs covering such data as composition and density tables, vapor pressure curves, solution temperatures, solubility of organic acids, salts, furfural gums and resins.

18

Heat-Treating. United States Steel Corp., Pittsburgh, Pa.—54-page booklet which outlines metallurgical principles used in the heat-treating of steel. It is well illustrated with charts, diagrams and photographs. Contains information on various phases and types of heat treatments. It appears to be a simple straight-forward discussion of the fundamentals of heat-treatment for metallurgists, heat treaters, production engineers and designers.

19

Industrial Forgings. Pittsburgh Forging Co., Coraopolis, Pa.—64-page illustrated brochure containing a pictorial review of the history, manufacturing facilities and war production of this company.

20

Injectors. Condenser Service & Engineering Co., Inc., Hoboken, N. J.—4-page leaflet illustrating and describing the Wizard condenser injector used in the application of leak proofing compound to various types of condensers. Describes the construction, operation and applications of this condenser.

21

Insecticides. Pennsylvania Salt Mfg. Co., Philadelphia, Pa.—4 pocket-size leaflets on various DDT insecticides manufactured by this company. Their titles are as follows: "Confused about Insecticides," "Pensalco Live Stock Spray," "Penco Cattle Spray," and "Knox-Out Garden Dust."

22

Instruments. The Bristol Co., Waterbury 91, Conn.—Catalog No. W1800. 24-page booklet illustrating and describing the complete line of modern industrial instruments available from this company.

23

Instruments. Brown Instruments Co., Philaphia 44, Pa.—Catalog No. 100-1. 40-page pyrometer catalog. Various types of thermocouples and accessories are illustrated including dimensions, specifications and prices of the various models and types. Contains a section on thermocouple and protecting tube selection as well as a two-page tabulation of suggested materials of construction to use for a wide number applications.

24

Instruments. Northern Equipment Co., Erie, Pa.—Bulletin 453. 6-page illustrated bulletin describing the control of boiler feed water in a large generating station.

25

Insulation Materials. Plant Rubber and Asbestos Works, San Francisco, Calif.—8-page pamphlet describing the use of precision molded, 85

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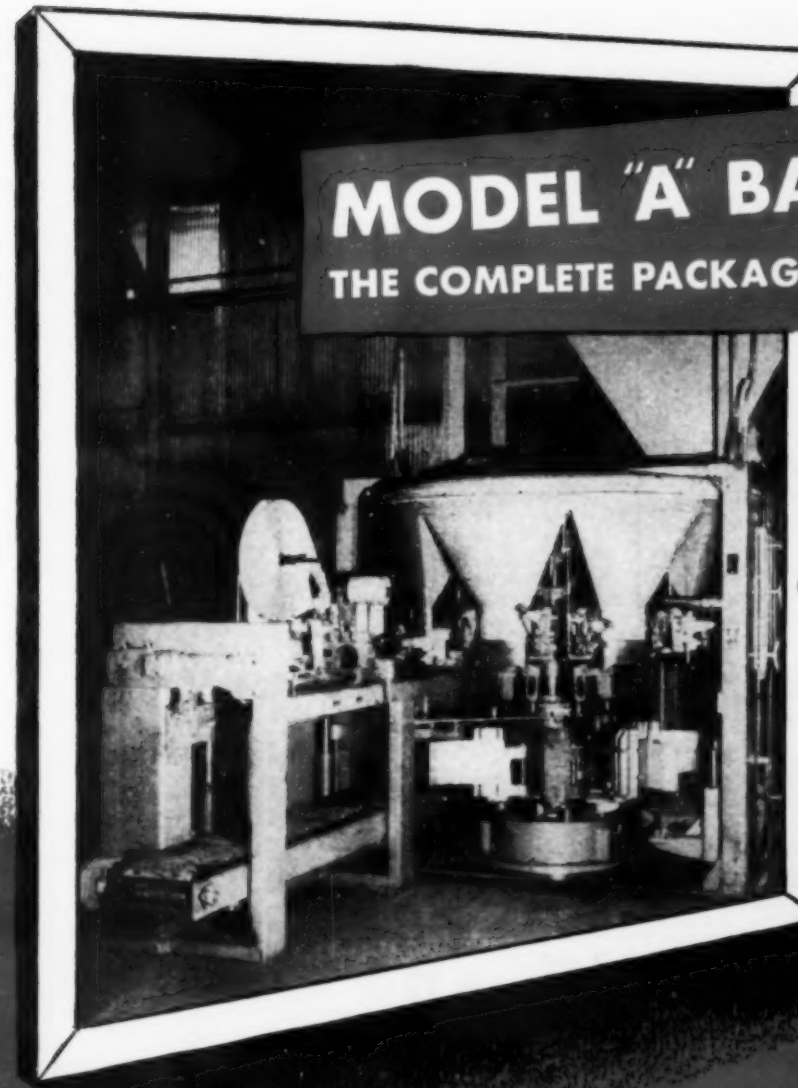

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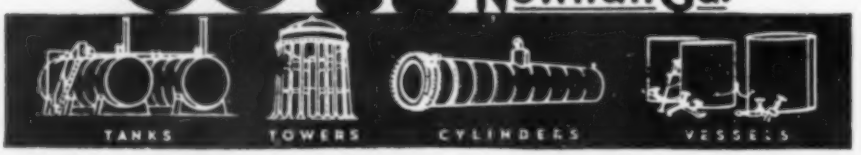

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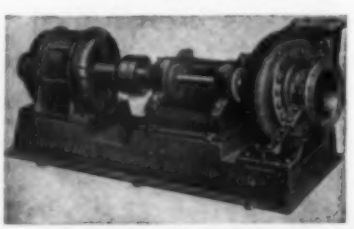

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percent magnesia pipe covering. Contains tables of insulation thicknesses for various pipe sizes.

26

Lighting Units. Consolidated Diesel Electric Corp., Mt. Vernon, N. Y.—2-page leaflet featuring the gasoline-driven floodlight units manufactured by this company.

27

Materials Handling. Robins Conveyors, Inc., Passaic, N. J.—Bulletin No. 124-F. 4-page booklet illustrates and describes the Robins portable floatex Shakeout equipped with automatic flask loader, a unit which lifts flasks off the foundry floors, deposits them on receiving table, turns them upside down on the deck, shakes out the sand and discharges the castings all in one quick series of operations.

28

Nylon. The Polymer Corp., Reading, Pa.—5-page technical bulletin describing the FM-1 nylon rods manufactured by this company. Included is data on physical properties, chemical resistance, and suggested uses.

29

Packaging. Bemis Bros. Bag. Co., St. Louis, Mo.—14-page illustrated brochure featuring the manufacture and use of Bemis multi-wall paper bags.

30

Packaging. Union Bag & Paper Corp., New York, N. Y.—4-page leaflet entitled "The Battle of the Bag" which features the strength of the multi-wall paper bags made by this company.

31

Photographic Equipment. Eastman Kodak Co., Rochester, N. Y.—4-page pamphlet showing plans and equipment for processing moderate amounts of photographic materials by the industrial, medical, or scientific photographer.

32

Pipe Fittings. Bert Borders & Co., San Francisco, Calif.—Bulletin No. 27. Bulletin describing the stainless steel high-pressure screw pipe fittings and flare fittings made by this company. Bulletin No. 19. Booklet describing stainless steel micro-regulating needle valves made by this company.

33

Plastics. General Electric Co., Pittsfield, Mass.—12-page color folder showing 18 different colors and patterns for decorating surfacing material of G-E Textolite for various uses. Includes information on properties, grades, and prices of the material, together with recommended uses. 20-page booklet entitled "One Plastics Avenue" which describes the facilities and services performed by this company in its various plants. Also 4-page leaflet illustrating and describing the plastic sealing caps and sleeves available from this company.

34

Pneumatic Conveyors. The Spencer Turbine Co., Hartford, Conn.—Bulletin No. 143. Four-page illustrated leaflet featuring the vacuum pneumatic conveying equipment manufactured by this company. Bulletin No. 142 illustrates and describes the Spencer Turbo Compressors for agitation and blowing of acid tanks, and other similar applications.

35

Process Equipment. H. K. Porter Co., Inc., Pittsburgh, Pa.—16-page illustrated booklet featuring the various types of process equipment available from this company. Also a four-page booklet illustrating and describing the Devine impregnators made by this company.

36

Protective Coatings. Prufcoat Laboratories, Inc., Cambridge, Mass.—11-page illustrated booklet featuring Prufcoat for coating concrete, structural steel, floors, pipes, tanks, machinery and other equipment for protection against corrosion.

37

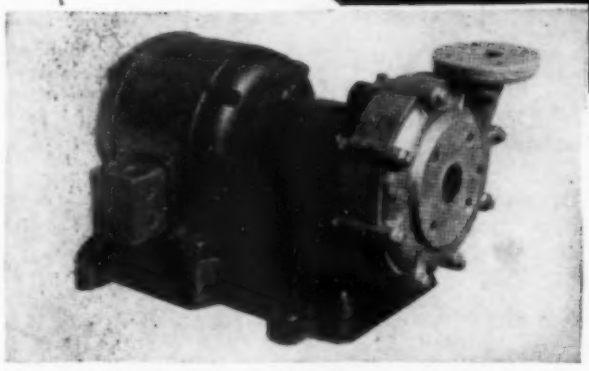
Pumps. Economy Pumps Inc., Hamilton, Ohio—Bulletin No. C 945. 8-page illustrated booklet featuring the horizontal split case, multi-stage, high-pressure centrifugal pumps. Details of construction are given, important features of design are shown, and selection tables are included.

38

Pumps. H. K. Porter Co., Inc., Pittsburgh, Pa.—Bulletin. New bulletin illustrates and describes the Streamflow Rotex pump used for moderate or low viscosity liquids under medium pressure. Contains complete specifications, dimensions and performance charts.

39

Reactivator. Graver Tank & Mfg. Co., Inc., Chicago, Ill.—8-page illustrated booklet describing the sludge blanket-type reactivator made by this company. Explains the principles and advantages of upward sludge filtration and describes the adaptability of this equipment to the effective treatment of both industrial and municipal water



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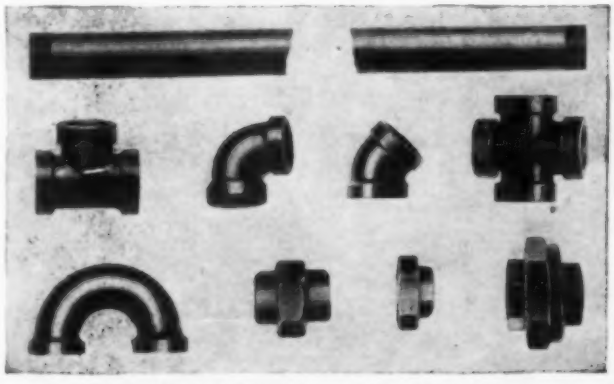

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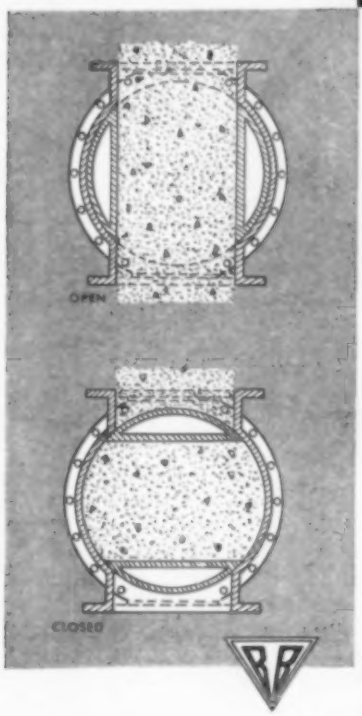

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supplies. Includes charts, flow diagrams, and cut-away drawings showing how this equipment operates.

40

Rubber Products. B. F. Goodrich Co., Akron, Ohio—22-page booklet entitled "Typical Examples of B. F. Goodrich Developments in Rubber." Contains reproduction of 22 advertisements used by this company during 1945. 12-page catalog section No. 9020 describing this company's Vulcalock process for lining tanks and tank cars with rubber. Dimensions of standard rubber-lined tanks for use with corrosive liquids are given and a complete discussion is included on methods of preparing the tanks or tank cars for operation. Also a 20-page booklet describing, by means of cartoon sketches, this company's suggestion system and its value to both the company and the employees.

41

Safety Equipment. Mine Safety Appliance Co., Pittsburgh, Pa.—4-page bulletin illustrates and describes this company's industrial gas mask for protection against individual industrial gases or a combination of gases, smokes, vapors and dust.

42

Saran. Dow Chemical Co., Plastics Div., Midland, Mich.—Technical data booklet on two new Saran coating materials—Saran F-120, a solvent soluble resin imparting very low moisture transmission and Saran F-122, a latex forming a continuous film upon air drying.

43

Sealing Compounds. J. F. Harbinson & Co., Buffalo, N. Y.—6-page pocket-size leaflet featuring Masters metallic compounds for use in a wide variety of applications. May be used as a lubricant on packing, for pipe threads, and other similar uses.

44

Steam Specialties. American District Steam Co., North Tonawanda, N. Y.—Bulletin No. 46-50. 16-page booklet describing the complete line of Adsco strainers and separators. Includes dimensions and list prices on this equipment. It is well illustrated with diagrammatic sketches and cut-away views of the various types and models.

45

Steam Specialties. Yarnall-Waring Co., Chestnut Hill, Philadelphia, Pa.—Bulletin WG-1815. 4-page leaflet featuring the Sealtite Try-Cocks manufactured by this company. Details of construction are given and a cut-away view illustrates how it works.

46

Textile Chemicals. Dexter Chemical Corp., New York, N. Y.—Reprint discussing removal of pectic substances from cotton yarn in mercerization processes as a source of dye affinity variation in mercerized yarn.

47

Textile Processing. The Hart Products Corp., New York, N. Y. 8-page booklet entitled "Mercerizing and Alkamerce." Contains information on mercerizing methods, caustic recovery, and discusses the important factors in this process.

48

Thermometers. Precision Thermometer and Instrument Co., Philadelphia, Pa.—Bulletin T. 12-page catalog illustrating and describing the mercury and glass thermometers, thermoregulators, and thermostats manufactured by this company.

49

Valves. Farris Engineering Co., Palisades Park, N. J.—Bulletin No. 40. This new bulletin gives the essential construction and operation specifications for 20 basic designs of improved safety and relief valves manufactured by this company. It includes data on high pressure valve, liquid release valves, diaphragm release valves, full-venturi and semi-venturi type of valves.

50

V-Belts. Multiple V-Belt Drive Association, Chicago, Ill. 16-page illustrated booklet describing in non-technical terms the advantages of multiple V-belt drives.

51

Washers. Hardinge Co. Inc., York, Pa.—Bulletin 37-A. 4-page illustrated leaflet describing the Hardinge Conical Scrubber for use in scrubbing gravel, stone, phosphate rock, gold ore and many other similar materials. It covers in detail various applications of this scrubber, principles of operation, capacity, and gives complete specifications of several models which have been built.

52

Waterproofing. Truscon Laboratories, Inc., Detroit, Mich. Booklet A. New specification book of Truscon waterproofing, and dampproofing compounds. Contains specifications, illustrations and description of products.

CHEMICAL ECONOMICS

H. M. BATTERS, Market Editor

INDUSTRIAL CONSUMPTION OF CHEMICALS IN FIRST SIX MONTHS WAS HIGHEST ON RECORD

IN THE FACE of many adverse conditions, including labor troubles, work stoppages, transportation difficulties, scarcity of containers and raw materials, industrial consumption of chemicals forged ahead to record heights in the first half of this year. The termination of war contracts while bringing a small curtailment in overall production of chemicals, enlarged the amount of raw materials available for civilian goods and the heavy consuming demand for the latter made up in most part for the loss in business with the war agencies. Comparing the first six months of 1946 and 1945, the present year appears to have registered a decline of about 30 percent in total industrial production and of about 3 percent in the output of industrial chemicals. For the same periods, industrial consumption of chemicals increased approximately 6 percent.

According to the unadjusted indexes of the Federal Reserve Board, all production dropped to 160 in May compared with a revised figure of 163 for April. The indexes for production of industrial chemicals were reported at a preliminary figure of 395 for May as against a revised figure of 392 for April. This would indicate a rising trend for chemical production in May but the data now available show rather marked declines from April in a long list of chemicals including such heavy tonnage items as sulphuric acid, soda ash, caustic soda, chlorine, phosphoric acid, calcium and sodium phosphates, synthetic anhydrous ammonia, and ammonium nitrate.

One factor which has affected total production of chemicals this year has been the sharp drop in the output of ethyl alcohol. Production for the first quarter of the year was reported at 74,614,731 proof gallons as compared with 163,261,008 proof gallons for the comparable period of last year. Since March, production has been on a declining trend and by the end of June, fermentation plants, except those of the Pacific Coast, were closed because the government supply of molasses had dwindled to a point where it was decided to conserve the supply for production of butyl alcohol. It was held that the government stockpile of alcohol—around 45 million gallons—plus the output of plants still in operation would take care of essential domestic requirements with the exception of alcohol for butadiene manufacture. Apparently the reopening of the closed fermentation plants is dependent on the successful outcome of present negotiations for Cuban molasses.

Industrial consumption of chemicals in June generally moved upwards with steel mills making a good recovery and enlarged operations reported in the paper, petroleum refining, rayon, and plastics fields. The *Chem. & Met.* index places industrial consumption of chemicals at 196.38 in May compared with a revised figure of 204.53 for April. Scarcity of raw materials and delays in transportation were responsible for checking the rising trend. Many coal-tar products are in small supply and have had a widespread effect on production of other products. The outlook for creosote oil is somewhat brighter as it is stated that larger imports from Great Britain will be received in the near future.

Developments in the rubber industry have been favorable inasmuch as the increase in price for natural rubber as agreed upon at the London meeting was not as large as had been feared. The question of supplies, however, has not changed materially and it is probable that imports of crude rubber for the calendar year will not exceed earlier estimates and may fall short of the 300,000 tons mark. All this has a direct bearing on production of synthetic rubber.

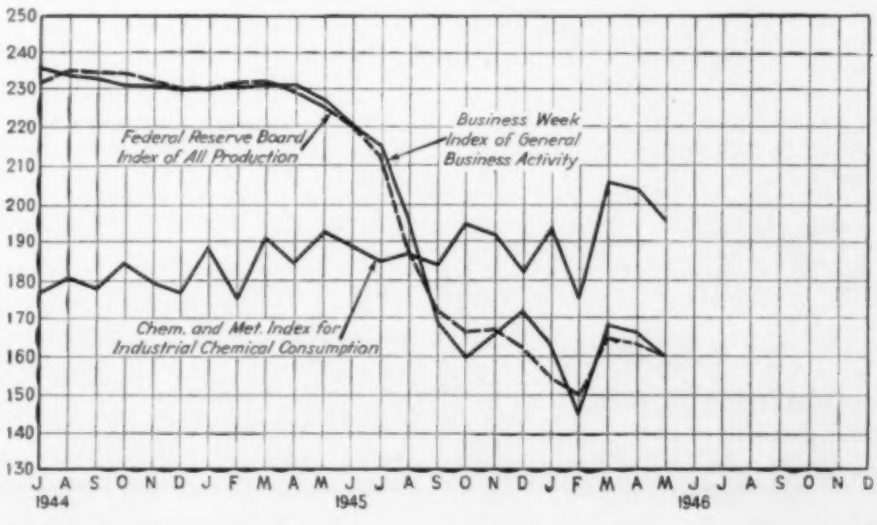
Chem. & Met. Index for Industrial Consumption of Chemicals

	April Revised	May
Fertilizers	47.67	42.86
Pulp and paper	22.08	22.20
Petroleum refined	17.66	19.40
Glass	21.14	20.30
Paint and varnish	23.49	23.52
Iron and steel	10.84	7.60
Rayon	20.81	20.65
Textiles	11.19	11.70
Coal products	7.04	5.02
Leather	4.60	4.70
Industrial explosives	4.91	6.38
Rubber	6.90	6.80
Plastics	6.20	5.25
	204.53	196.38

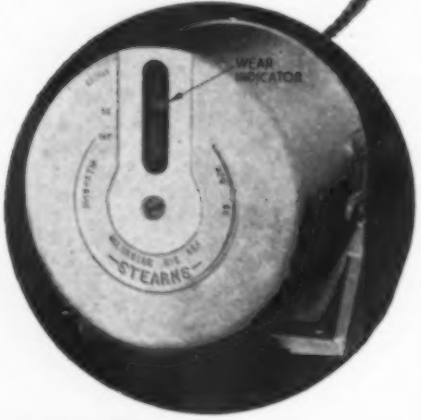
Prices for chemicals have followed the general trend and are moving upwards. Basically, conditions point to a readjustment of prices practically throughout the entire list of chemicals. There is a wealth of buying power, a preponderance of demand over supply, and a considerable time lag before production can overtake the backlog of orders. In addition, production costs as represented by higher wage scales and higher costs of raw materials, have gone up in recent months and in some branches of the industry heavy expenditures are in prospect in order to repair or replace equipment which was kept in uninterrupted operation throughout the war period.

However, it is probable that no undue rise will take place in sales schedules. Moderate adjustments are necessary in many cases in order to restore normal profit margins and an orderly revision of these inequities may be expected to follow but the long-term trend of chemical prices has been downwards and while this movement was reversed by the prevalence of wartime conditions and by recent postwar developments, it is probable that price revisions for chemicals will be selective rather than general.

In World War I and in the years immediately following, a large part of trading in chemicals was in the hands of middlemen with products frequently being sold several times before reaching the ultimate consumer. Since that time the bulk of trading has been direct between producer and consumer or between producers accredited sales representatives and consumers. This has reduced to a minimum all speculative influences and makes it possible to establish sales prices on a proper relationship to production costs.



FOR BETTER BRAKE Performance



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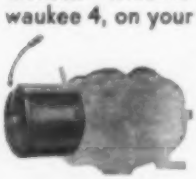
A Magnetic Disc Brake that will develop a torque of 575 lbs. or the equivalent of 100 HP at approximately 1000 RPM, now is available in the Stearns 1300 Series. It can be supplied in floor or motor mounting types for AC or DC current.

We can help you solve problems involving effective retarding of motors or machinery, whether for one or a sequence of controlled stops, whether for horizontal or vertical mountings.

Stearns Magnetic Disc Brakes are being used efficiently and satisfactorily by outstanding motor manufacturers and machinery makers in hundreds of exacting operations.

Consult Stearns Magnetic, Milwaukee 4, on your braking problems.



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SULPHURIC ACID PRODUCTION INCREASED LAST YEAR

In a special report on sulphuric acid the Bureau of the Census revealed that new acid production in 1945 amounted to 8,687,000 tons of 100 percent, an increase of 147,693 tons over the 1944 total. The rise was largely in the Baltimore area where production was 876,267 tons or 115,091 tons greater than in 1944.

Gross production of sulphuric acid in 1945 amounted to 9,522,697 tons as compared with 9,242,202 tons in 1944, these totals including the production of new acid and spent acid which was fortified. The amount of spent acid consumed in fortification was 835,627 tons in 1945 and 702,825 tons in 1944. In 1944, 3,052,457 tons of the gross production was consumed at producing plants. Comparable data for 1945 are not available as this information was not gathered after September but for the 9 months ended September this consumption amounted to 2,141,740 tons which represents a drop from the monthly average of 1944.

Statistics on acid are compiled for 177 commercial plants operated during 1945. As of December 1945, there were 174 reporting plants, 88 producing acid by the contact process and 101 by the chamber process. Fifteen plants reported production by both processes. During the year three plants discontinued production. Data for government-owned plants which are operated by private interests and which serve industrial users are included but data for government plants operated in conjunction with ordnance works and arsenals are not included.

Production and Consumption of Sulphuric Acid By Areas

Short tons, 100 percent acid

	Production 12 Months		Production and Consumption January Through September			
	1945 Total New Production	1944 Total New Production	1945 Total New Production	1945 Consumption in Producing Plants	1944 Total New Production	1944 Consumption in Producing Plants
Total	8,687,070	8,539,377	6,655,676	2,141,740	6,279,499	2,304,404
New England	182,748	181,972	138,246	54,016	127,132	60,257
New York City	843,285	889,892	652,281	348,847	637,178	326,246
Philadelphia	637,767	656,145	505,829	211,578	479,410	204,094
Baltimore	876,708	761,617	670,221	203,726	551,571	234,783
Richmond-Norfolk	146,719	151,122	112,401	114,829	113,903	116,241
Southeast	637,883	608,295	452,812	108,388	466,108	99,963
South Atlantic	697,200	678,122	520,961	468,289	499,325	482,736
Cincinnati	279,568	280,381	210,240	39,005	208,478	36,812
Pittsburgh	661,479	697,967	501,600	27,619	449,732	35,165
Great Lakes	734,332	763,096	564,085	122,181	553,348	136,851
Chicago	731,273	731,006	559,551	145,351	538,419	151,288
St. Louis	514,268	543,984	375,501	147,670	414,806	249,339
South West Central	281,611	342,787	229,657	15,483	257,750	26,949
Gulf Coast	732,263	624,871	594,759	78,429	440,957	71,808
Western	690,466	718,120	567,532	56,329	521,382	71,875

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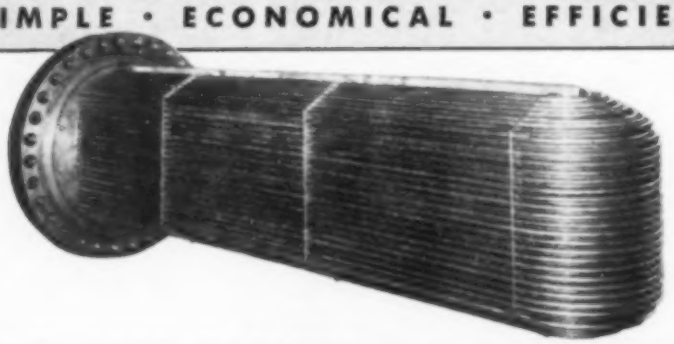

WHITLOCK EXCHANGER U-TUBE DESIGN

A pioneer in the development of U-tube Heat Exchangers, Whitlock today is a leader in the manufacture of units of this type for the process industries. Whitlock U-tube design offers many advantages in coolers and heaters where the tube fluid is relatively non-fouling. Wide temperature differentials are practical, as the coil section is free to expand or contract without stress, independent of the shell. U-tube construction eliminates much of the material needed in other designs — the usual floating tube sheet, floating head and rear head of shell and saves the time required for machining and assembling these parts. Simplicity, economy and efficiency favor U-tube design for many installations.

Whitlock Engineers will gladly make recommendations and specify the proper equipment to solve your problem.

Write for information

THE WHITLOCK MANUFACTURING CO.

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WALWORTH LUBRICATED PLUG VALVES

offer these advantages

- . . . Direct port opening
- . . Quarter turn opens or closes valve
- . . . Dead tight shut-off
- . . . Freedom from attack by fluids being handled
- . . . Pressure sealed
- . . Made in a complete line. Sizes from ½" to 24" for pressures from 175 to 5,000 psi., and for vacuum requirements

THESE are just a few of the reasons why Walworth Lubricated Plug Valves give "top" performance on many *difficult* services.

All Walworth Lubricated Plug Valves employ special insoluble lubricants which protect the plug and body against contact with the line fluid, thus combatting erosion and corrosion.

The lapped surfaces of the valve are "pressure sealed" when the valve is in either the open or closed position. By turning the lubricant screw, lubricant is forced under high pressure through a grooving system that completely encircles the ports as well as the top and bottom of the plug.

The lubricant seals the valve against leakage, and reduces friction between plug and body. This permits easy, quick, full-opening, or tight shut-off with only a quarter turn of the plug.

Number 1700 (illustrated) is a Steel-iron valve, wrench operated, designed for a working pressure of 200 pounds WOG (water, oil, or gas). Valves are available in either screwed or flange types. Screwed type have API line pipe thread lengths. Flanged type (No. 1700F) is faced and drilled to American Standard for 125-pound cast iron flanges unless otherwise specified.

For further information about No. 1700 as well as the complete line of Walworth Lubricated Plug Valves, write for catalog.

WALWORTH

valves and fittings

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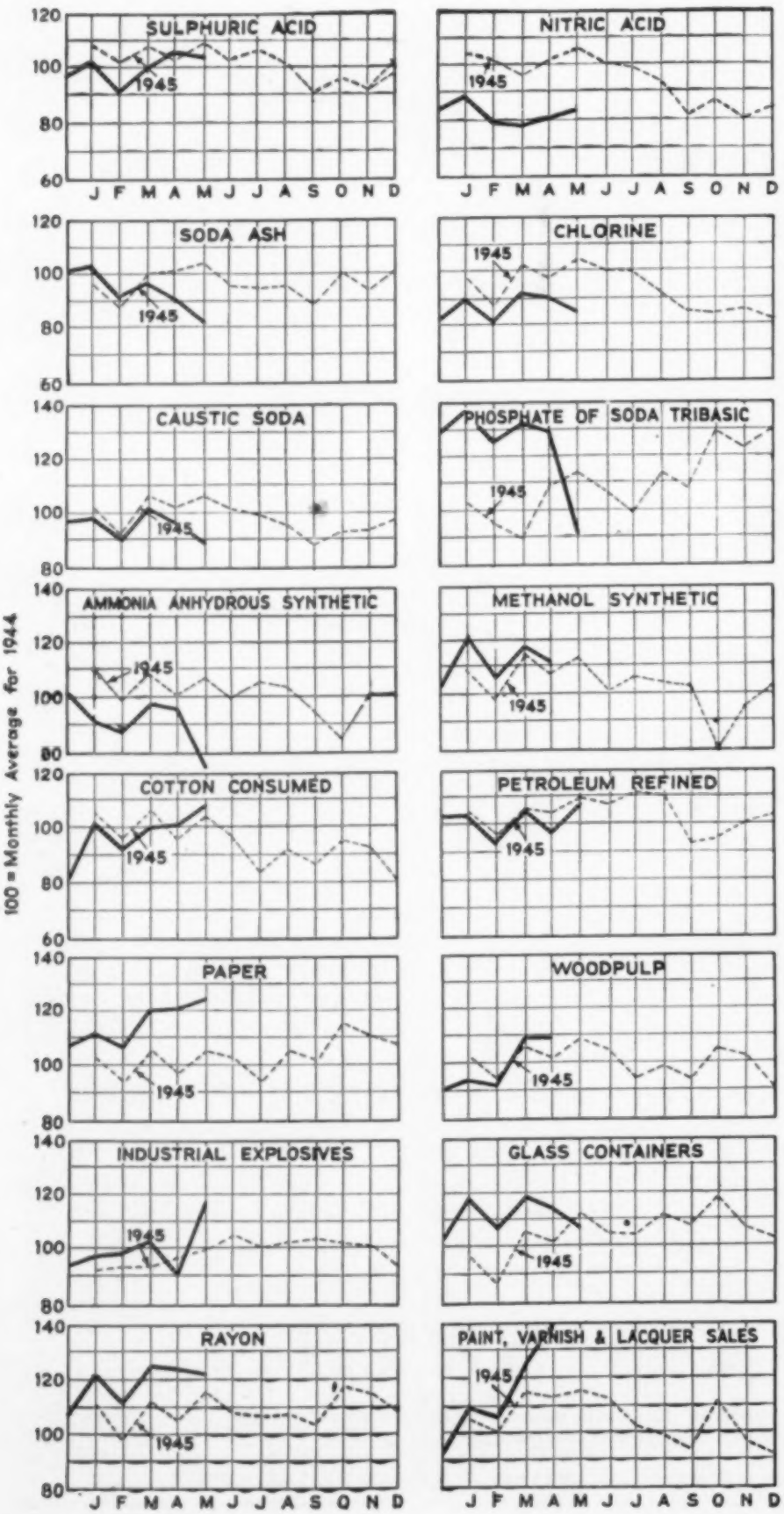
DISTRIBUTORS IN PRINCIPAL CENTERS THROUGHOUT THE WORLD

PRODUCTION AND CONSUMPTION TRENDS



PRODUCTION of superphosphate in May fell a little more than 10 percent below the April output and while acidulating plants may not maintain the high rate that has marked operations in recent months, the slowing up in the summer months which was common in prewar years, has been eliminated largely because a fairly uniform monthly output is necessary to turn out the amount of superphosphate our annual requirements now call for. Seasonal trends in many other lines also have disappeared in large part with consuming demand running high and inventories of raw materials and finished products at low levels.

While the supply situation has given concern for some months, the decision to close alcohol plants because of the shortage of molasses has made it more probable that some alcohol consumers will not be able to cover their requirements. In making the announcement Civilian Production Administration stated that sufficient alcohol will be available for domestic industrial consumption except in the production for synthetic rubber. Despite this assurance, there is a conviction that the anti-freeze trade will be faced with a shortage. There still is an attempt to get more grain assigned for fall production of alcohol and there has been some speeding up of facilities for the synthesis of methanol generally by conversion of ammonia plant equipment. However the incessant demand for more nitrogen fertilizer has prevented CPA from doing what its own Chemical Division has wanted in this regard. Serious scarcity of both methanol and industrial alcohol for anti-freeze purposes is, therefore, expected this fall.

Industrial consumers who have been affected by the scarcity of corn starch will be in a somewhat better position this month as on June 30 the Department of Agriculture began to loan sufficient corn to wet millers to enable them to continue production on a minimum basis through July. A list was drawn up of the industries in most critical need of starch and the millers will use this list to base their shipments of starch made from corn obtained under this arrangement. This does not mean that corn starch will be in ample supply. From present indications about one million pounds will be made this year and full consuming requirements probably would exceed one and one-half times that amount.

The possibility of work stoppages at chemical plants has not been removed as one of the largest producers was notified early this month that workers would go on strike if their demands were not met. However, the strike at a western alkali plant which went into effect on May 1 was settled on June 30 and production of alkalis at the plant is expected to be normal before the end of this month. Shortage of alkalis has cut down activities in some of the consuming industries.

The price tone for chemicals is getting progressively stronger. As this is written, the status of OPA remains in doubt but some marking up of prices has occurred in the last month and announcement of forthcoming

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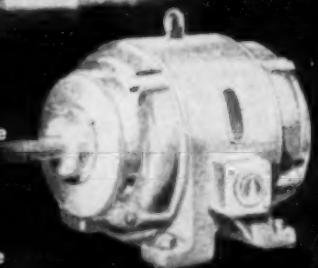
WHY NOT **place your pumping difficulties in the hands of recognized experts—men who have the broadest line, unlimited manufacturing facilities and a 116-year-old background of scientific research to offer you? See your Fairbanks-Morse dealer or call our local branch office now.**



SILENT MEMBER— **An added advantage is the line of electric motors designed and built by Fairbanks-Morse—for use on Fairbanks-Morse pumps. *They cut your pump selection job in half*—give you a pump manufacturer ready to take *all* the responsibility in selecting your pump and the power to operate it!**

OUT OF THE HOLE—Fairbanks-Morse and Pomona deep-well turbine pumps have long been at home in bringing water out of the hole at rock-bottom cost—on farms, factories and wherever vertical turbines are used.

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A name worth remembering

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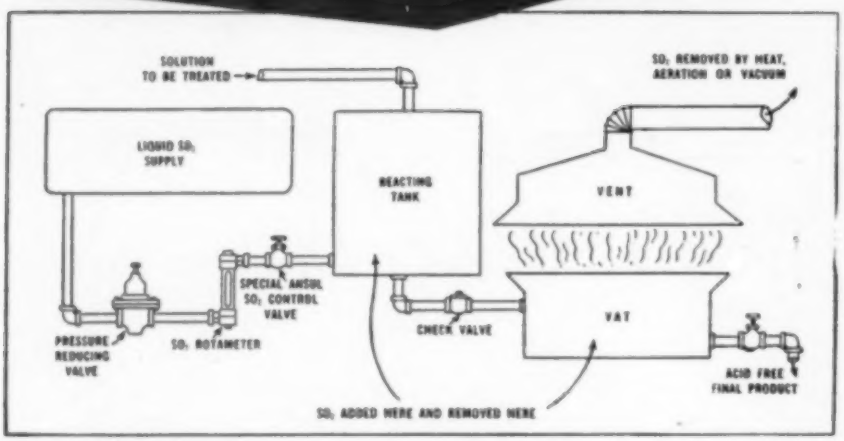
SCALES · STOKERS · RAILROAD MOTOR CARS and STANDPIPES · FARM EQUIPMENT

EVAPORATE EXCESS ACIDITY

Use ANSUL SO_2 as an acidifying agent and remove excess by heat, aeration or vacuum



Here is a typical SO_2 acidifying and precipitating system showing how the SO_2 is introduced and excess acidity removed.

• Ansul SO_2, a volatile acid, provides distinct advantages over mineral acids when used as an acidifying and precipitating agent. 1—Excess acidity is easily eliminated. 2—Residual acidity that might otherwise be concentrated as an impurity in the final product is minimized.

Ansul Liquid SO_2 is pure, inexpensive—easy to handle. It has unusual bleaching and preservative qualities and its use results in products of greater purity.

Liquid Sulfur Dioxide ANSUL

PHYSICAL PROPERTIES

Chemical formula	SO_2
Molecular weight	64.06
Color (gas and liquid)	Colorless
Odor	Characteristic, pungent
Melting point	−103.9° F. (−75.5° C.)
Boiling point	14.0° F. (−10.0° C.)
Density of liquid at 80° F.	(85.03 lbs. per cu. ft.)
Specific gravity at 80° F.	1.363
Density of gas at 0° C. and 760 mm.	2.9267 grams per liter (0.1827 lb. per cu. ft.)
Critical temperature	314.82° F. (157.12° C.)
Critical pressure	1141.5 lbs. per sq. in. abs.
Solubility	Soluble in water
Purity	99.9+% (by wt.) SO_2 (H_2O less than 0.01%)

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ANSUL CHEMICAL COMPANY
INDUSTRIAL CHEMICALS DIVISION, MARINETTE, WIS.
Eastern Office: 60 E. 42nd St., New York City.

advances for some of the large tonnage chemicals has been made although new sales figures which were to go into effect on July 1 have been withheld temporarily. Some of the chemical products which are important in our import trade, have been advanced in primary markets and naturally this is reflected in domestic markets. The sharp rise in prices for shellac in India and in domestic markets offers a typical example.

Ceiling prices for babassu oil recently were advanced and it is now announced that the United States-Brazilian babassu agreement which would expire on July 25, has been extended for another year. The Commodity Credit Corp. or its designees will purchase the entire exportable surplus of Brazil either in the form of kernels or of oil. Prices for the oil are 11c. a lb. in bulk and 12c. a lb. in drums fob. Brazilian ports.

CARBON BLACK PRODUCTION MADE RECORD LAST YEAR

Reporting on the carbon black industry, the Bureau of Mines says that in 1945, both production and sales for the first time exceeded one billion pounds. The production total of 1,052,798,000 lb. was an increase of 31 percent over the 1944 figure. The rate of output was below demand until early summer when demand for military tires fell off and eased the situation. In the latter part of the year, production overtook the rate of sales and producers' stocks increased to 102,005,000 lb. on December 31, compared with 69,243,000 lb. at the close of 1944.

Gas consumed in carbon black manufacture increased 21 percent over 1944 to a new record of 431,830 million cubic feet. Average yield of carbon black was 2.32 lb. per 1,000 cu.ft. of gas in 1945 and 2.20 lb in 1944. Average value of natural gas used increased to 2.28c. per 1,000 cu.ft. from 1.62c. in 1944. Value of carbon black at the plants rose to 4.02c. a lb., the highest average since 1929.

There were 58 plants in operation in 1945 compared with 54 in 1944. Two plants (one roller in Kansas and one channel in Louisiana) were not operated in 1945. Five new channel plants (two in New Mexico, one in Oklahoma, and two in Texas) and one new furnace plant in Texas, began operations.

Carbon Black Production And Sales
1944-1945

	1944	1945
Number of producers	22	21
Number of plants	54	58
Production, 1,000 lb.		
Louisiana	160,019	168,229
Texas		
Panhandle district*	401,556	541,464
Rest of state	99,606	179,974
Total Texas	501,162	721,438
Other states	140,679	163,131
Total United States*	801,860	1,052,798
By processes		
Contact process	414,676	538,539
Furnace process*	387,184	514,259
Domestic sales, 1,000 lb.		
Rubber companies	738,029	804,386
Ink companies	24,479	22,824
Paint companies	5,315	7,421
Miscellaneous	12,616	11,631
Total	780,439	846,262
Exports	156,991	173,773
Total sales	937,430	1,020,035
Producer stocks, Dec. 31	69,243	102,005

* Includes carbon black produced from liquid hydrocarbons.

MEMO
TO - ENGINEERING STAFFS
Consult D.P.I. on problems of vacuum technology within the range of 0.0000001 mm. HG to 5.0 mm. HG -- Write Vacuum Equipment Division.

DISTILLATION PRODUCTS, INC. ROCHESTER 13, N.Y. DP INC.

A NEW "SOLID" SPRAY NOZZLE

Fig. H-630

Here is a new nozzle with two round tangential inlets (instead of several small slots) which permit relatively large solid particles to pass right through and out the orifice. Produces fine breakup, even distribution, and solid cone spray suitable for numerous applications.

Available in Brass, or made to order in any machinable material. 1/4" I.P.S., capacities from 12 to 75 gph @ 10 lbs. water pressure.

Send Monarch an outline of your spray problem—if the liquid can be sprayed with direct pressure at all—Monarch can furnish the nozzle.

NOZZLES FOR:

- ACID CHAMBERS
- AIR WASHING
- CHEMICAL PROCESSING
- COOLING POND
- DESUPERHEATING
- GAS SCRUBBING
- HUMIDIFYING
- OIL BURNERS
- SPRAY DRYING

Do you have our Catalogs 6A and 6C?

MONARCH MFG. WORKS, INC.

2730 E. WESTMORELAND ST.

PHILADELPHIA 34, PA.

United States Production of Certain Chemicals

April 1946, April 1945, and Four-Month Totals for 1946 and 1945

Chemical	Units	April 1946	April 1945	Total, Four Months 1946	Total, Four Months 1945
Ammonia, synthetic anhydrous[1]	Tons	43,358	45,581	168,751	189,389
Ammonium nitrate (100% NH_4NO_3)	Tons	42,680	.....	161,778	.....
Ammonium sulphate, synthetic (technical)	M lb.	16,352	.....	70,566	.....
Calcium arsenate (100% $Ca_3(AsO_4)_2$)	M lb.	3,256	1,568	6,922	7,572
Calcium carbide (commercial)	Tons	40,014	64,610	169,982	245,851
Calcium phosphate:					
Monobasic (100% $CaH_4(PO_4)_2$)	M lb.	5,158	4,722	23,669	20,782
Dibasic (100% $CaHPO_4$)	M lb.	6,863	4,020	29,929	14,929
Carbon dioxide:					
Liquid and gas	M lb.	17,184	17,578	68,204	70,048
Solid	M lb.	58,185	63,075	182,749	198,344
Chlorine	Tons	94,865	103,478	365,852	406,963
Chrome green (C.P.)	M lb.	1,649	407	7,181	2,124
Chrome yellow and orange (C.P.)	M lb.	4,129	3,552	17,625	13,496
Hydrochloric acid (100% HCl)	Tons	26,974	37,597	107,438	144,062
Hydrofluoric acid	M lb.	3,822	.....	12,220	.....
Hydrogen	M cu. ft.	1,385,000	2,100,000	5,691,000	8,178,000
Lead arsenate (acid and basic)	M lb.	8,665	9,737	31,408	34,141
Molybdate chrome orange (C.P.)	M lb.	469	135	1,815	501
Nitric acid (100% HNO_3)	Tons	31,311	40,053	128,102	158,959
Oxygen	M cu. ft.	884,868	1,401,301	3,257,613	5,617,396
Phosphoric acid (50% H_3PO_4)	Tons	70,749	59,568	283,529	215,450
Soda ash (commercial sodium carbonate):					
Ammonia soda process (98–100% Na_2CO_3):					
Total wet and dry[2]	Tons	342,749	378,385	1,452,875	1,456,426
Finished light[3]	Tons	172,630	210,130	721,373	786,115
Finished dense	Tons	117,344	114,133	513,229	450,515
Natural[4]	Tons	14,788	15,171	64,704	58,364
Sodium bicarbonate (refined) (100% $NaHCO_3$)	Tons	17,444	15,407	74,745	55,143
Sodium bichromate and chromate	Tons	7,857	6,852	30,483	27,309
Sodium hydroxide (100% NaOH):[5]					
Electrolytic process:					
Liquid	Tons	92,396	97,440	353,255	384,728
Solid	Tons	15,844	18,577	63,741	75,462
Lime soda process:					
Liquid	Tons	58,936	63,860	255,693	251,370
Solid	Tons	17,813	19,840	86,657	79,073
Sodium phosphate:					
Monobasic (100% NaH_2PO_4)	Tons	1,054	1,535	4,399	4,765
Dibasic (100% Na_2HPO_4)	Tons	5,961	4,850	22,924	18,035
Tribasic (100% Na_3PO_4)	Tons	8,638	7,312	36,448	26,658
Meta (100% $NaPO_3$)	Tons	2,294	2,023	10,639	8,007
Tetra (100% $Na_4P_2O_7$)	Tons	4,935	3,597	29,035	12,344
Sodium silicate	Tons	29,914	36,796	129,124	145,873
Sodium sulphate:					
Anhydrous (refined) (100% Na_2SO_4)[6]	Tons	26,499	6,799	95,274	27,630
Glaubers salt[7]	Tons	13,465	18,228	54,153	71,060
Salt cake (crude, commercial)	Tons	30,546	43,534	117,421	180,528
Sulphuric acid (100% H_2SO_4):[7]					
Chamber process	Tons	282,452	262,387	1,018,663	1,112,098
Net contact process[8]	Tons	472,857	475,590	1,743,147	1,898,091

Data for this tabulation have been taken from "Facts for Industry" series issued by Bureau of the Census and WPB Chemicals Bureau. Production figures represent primary production and do not include purchased or transferred materials. Quantities produced by government-owned arsenals, ordnance works, and certain plants operated for the government by private industry are not included. Chemicals manufactured by TVA, however, are included. All tons are 2,000 lb. Where no figures are given, data are either confidential or not yet available. [1] Includes a small amount of aqua ammonia. [2] Total wet and dry production, including quantities diverted for manufacture of caustic soda and sodium bicarbonate, and quantities processed to finished light and finished dense. [3] Not including quantities converted to finished dense. [4] Data collected in cooperation with the Bureau of Mines. [5] Figures represent total production of liquid material, including quantities evaporated to solid caustic and reported as such. [6] Includes oleum grades. Excludes spent acid. [7] Data for sulphuric acid manufactured as a byproduct of smelting operations are included. This production by eight smelters was formerly reported to the Bureau of Mines.

United States Production of Certain Synthetic Organic Chemicals

March 1946, March 1945, and Three-Month Totals for 1946 and 1945

Chemical	March 1946	March 1945	Total, Three Months 1946	Total, Three Months 1945
Acetanilid, technical and U.S.P.	606,668	620,302	1,778,581	1,111,467
Acetic acid:				
Synthetic[1]	25,008,262	23,266,187	65,896,788	71,495,021
Recovered	95,311,071	.....	243,928,283	.....
Natural[2,3]	1,738,155	2,811,107	5,434,582	8,816,162
Acetic anhydride[3]	44,026,772	47,675,185	128,090,249	134,231,722
Acetone	27,981,806	.....	80,661,781	.....
Aniline	7,607,352	.....	21,083,396	.....

(*Continued on page 298*)

WHAT MAKES A MAILING CLICK?

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Both types are substantially lighter in weight than comparable drums of heavy-metal construction. But there's much more in their favor than just this weightsaving—

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U. S. Production of Synthetic Organic Chemicals (Cont. from p. 296)

Chemical	March 1946	March 1945	Total Three Months 1946	Total Three Months 1945
Acetylsalicylic acid	976,421	924,117	2,896,635	2,626,821
Barbituric acid derivatives[2]:				
5-Ethyl-5-phenylbarbituric acid and salts (Phenobarbital)	34,105	32,047	89,272	72,162
Benzene:				
Motor grade:				
Tar distillers[4]	971,183		2,988,864	
Coke-oven operators[5]	3,057,504		7,134,833	
All other grades:				
Tar distillers[4]	1,726,978		5,219,068	
Coke-oven operators[5]	10,303,242		21,411,043	
Butyl alcohol, primary, normal	7,890,619		24,189,791	
Carbon bisulphite	24,224,250		73,808,191	
Carbon tetrachloride	12,562,263		37,573,224	
Chlorobenzene, mono	21,808,624		63,677,203	
Creosote oil:				
Tar distillers[3]	10,569,755	12,568,662	28,028,956	32,559,582
Coke-oven operators[6]	2,725,111	3,463,613	5,439,600	9,580,523
Cresols[7]				
Meta-para	405,555	589,526	978,706	1,747,918
Ortho-meta-para	705,560	881,564	2,014,484	2,414,522
Cresylic acid, refined[7,10]	2,465,361	2,574,089	5,521,722	7,984,329
Dibutyl phthalate	1,428,525			
Dichloro diphenyltrichloroethane (DDT)	3,380,309		10,091,822	
Ethyl ether, technical and U.S.P.	3,739,257	8,682,245	6,623,335	22,812,742
Ethyl acetate (85%)	7,750,675	9,244,430	20,582,818	27,416,964
Formaldehyde (37% by weight)	41,822,668		119,287,268	
Methanol:				
Synthetic	46,419,578	45,092,240	136,031,515	126,645,400
Natural[9]	1,543,126	1,666,640	3,944,075	4,833,920
Naphthalene:				
Tar distillers (less than 79° C.)[3]	15,108,529	18,168,471	41,168,445	49,381,659
Tar distillers (79° C. and over)[3]	8,386,064	5,745,529	24,830,899	16,482,062
Coke-oven operators (less than 79° C.)[6]	7,104,529	7,934,492	13,503,561	22,179,483
Penicillin[8]	1,990,734		5,206,722	
Phenol (synthetic and natural)[7]	16,968,899		46,843,628	
Phthalic anhydride	9,776,815	11,375,340	25,932,411	31,300,797
Styrene (government owned plants only)	30,870,869		83,708,393	
Toluene:				
Coke-oven operators[7]	1,782,474		3,992,896	
All others[5,10]	1,209,382		3,178,500	

All data in pounds except benzene (gal.), creosote oil (gal.), toluene (gal.), and penicillin (million Oxford units). Statistics collected and compiled by U. S. Tariff Commission except where noted. Absence of data on production indicates either that returns were unavailable or confidential. [1] Excludes the statistics on recovered acid. [2] Acid produced by direct process from wood and from calcium acetate. [3] All acetic anhydride including that from acetic acid by vapor-phase process. [4] Product of distillers who use purchased coal tar only or from oil-gas or water-gas tar produced or purchased by tar distillers. [5] Statistics are given in terms of bulk medicinals only. [6] Statistics collected by the Bureau of Mines. [7] Total production including data reported both by coke-oven operators to Bureau of Mines and by distillers of purchased coal tar to the U. S. Tariff Commission. [8] Reported to U. S. Bureau of the Census. [9] Reported in gal. by Bureau of the Census but converted to lb. for comparison with the production of synthetic methanol. [10] Includes toluene produced from petroleum by any process. [11] Includes refined cresylic acid derived from petroleum.

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No. 5421

For handling concentrated Sulphuric and other acids, difficult to seal by stuffing box packing...TABER Vertical Pumps is a logical answer.

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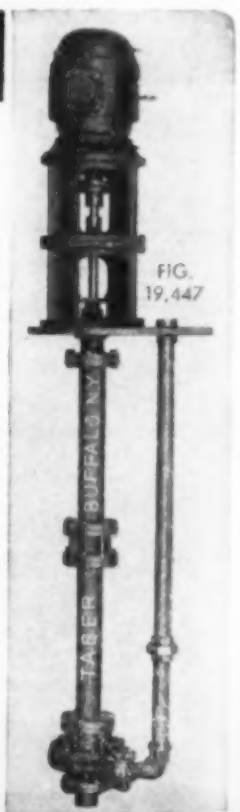

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Bulletin V-837

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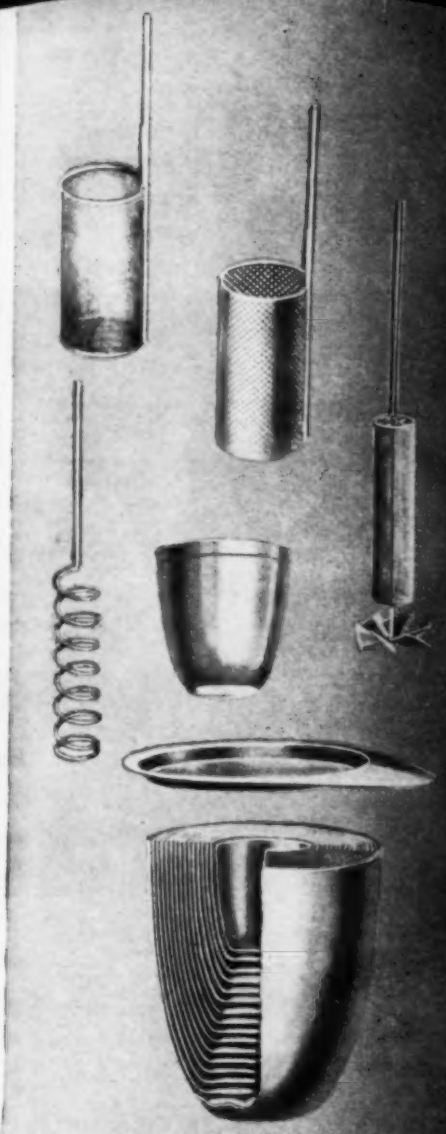

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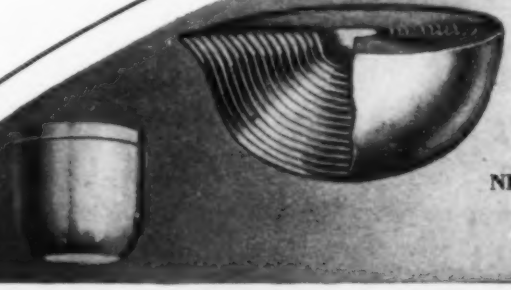

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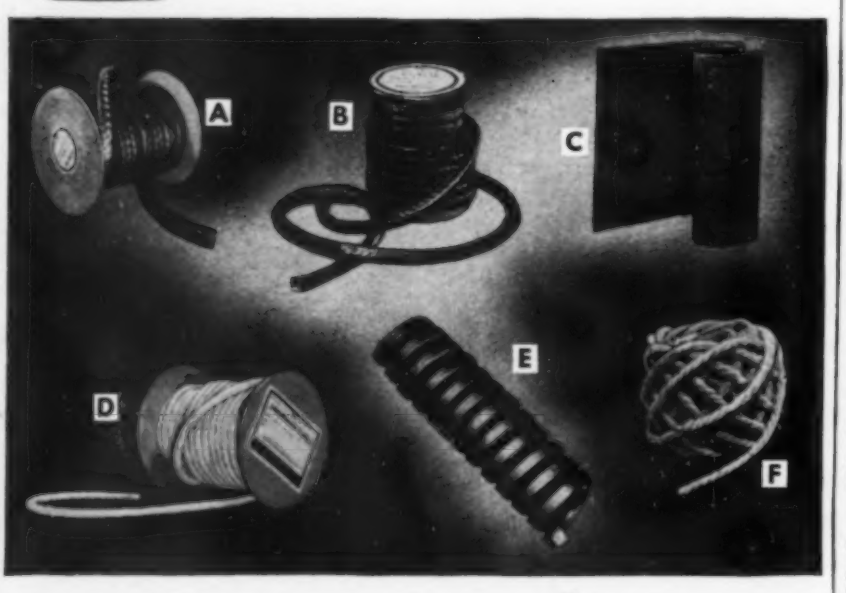

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PACKINGS & GASKETS

CHEM. & MET.

Weighted Index of Prices for CHEMICALS

Base = 100 for 1937

This month	**110.59**
Last month	109.13
July, 1945	108.70
July, 1944	109.50

CURRENT PRICES

The accompanying prices refer to round lots. Where it is trade custom to sell f.o.b. works, quotations are so designated. Prices are corrected to July 15.

INDUSTRIAL CHEMICALS

Acetone, tanks, lb	$0.06 –
Acid, acetic, 28% bbl., 100 lb	3.38 – $3.63
Boric, bbl., ton	109.00 – 113.00
Citric, drums, lb	.22½ – .23
Formic, cbys, lb	.10½ – .11
Hydrofluoric, 30%, drums, lb	.08 – .085
Lactic, 44% tech., light, bbl., lb	.073– .075
Muriatic, 18°, tanks, 100 lb	1.05 –
Nitric, 36°, carboys, lb	.05 – .05½
Oleum, tanks, wks, ton	18.50 – 20.00
Oxalic, crystals, bbl., lb	.11½ – .12½
Phosphoric tech., tanks, lb	.04 –
Sulphuric, 60°, tanks, ton	13.00 –
Tartaric, powd., bbl., lb	.62 – .65
Alcohol, amyl from pentane, tanks, lb	13½ –
Alcohol, buyl, tanks, lb	.10½ – .219
Alcohol, ethyl, denatured, No. 1 special, tanks, gal	.542 –
Alum, ammonia, lump, lb	.04½ –
Aluminum sulphate, com. bags 100 lb	1.15 – 1.45
Ammonia, anhydrous, cyl., lb	.14½ –
tanks, ton	59.00 – 61.50
Ammonium carbonate, powd., casks, lb	.09½ – .10
Sulphate, wks, ton	28.20 –
Amyl acetate, tech. from pentane, tanks, lb	.14½ –
Aqua ammonia, 26°, drums, lb	.02½ – .03
tanks, ton	65.00 –
Arsenic, white, powd., bbl., lb	.05 – .05½
Barium carbonate, bbl., ton	65.00 – 75.00
Chloride, bbl., ton	75.00 – 78.00
Nitrate, casks, lb	.09½ – .11
Blanc fix, dry, bags, ton	60.00 – 70.00
Bleaching powder, f.o.b., wks., drums, 100 lb	2.50 – 3.00
Borax, gran., bags, 100 lb	45.00 –
Calcium acetate, bags, 100 lb	3.00 –
Arsenate, dr., lb	.07½ – .08
Carbide, drums, ton	50.00 –
Chloride, flake, bags, del., ton	18.50 – 25.00
Carbon bisulphide, drums, lb	.05 – .05
Tetrachloride, drums, gal	.73 – .80
Chlorine, liquid, tanks, wks., 100 lb	1.75 – 2.00
Copperas, bgs., f.o.b., wks., ton	17.00 – 18.00
Copper carbonate, bbl., lb	.19½ – .20
Sulphate, bbl., 100 lb	5.65 – 6.15
Cream of tartar, bbl., lb	.50 – .52
Diethylene glycol, dr. lb	.14½ – .15½
Epsom salt, dom., tech., bbl., 100 lb	1.80 – 2.00
Ethyl acetate, tanks, lb	.08½ – .11½
Formaldehyde, 40%, tanks, lb, wks	.032 –
Furfural, tanks, lb	.09½ –
Glaubers salt, bags, 100 lb	1.05 – 1.10
Glycerine, c.p., drums, extra, lb	.18½ – .19
Lead: White, basic carbonate, dry, casks, lb	.11 –
Red, dry, sck., lb	.12½ –
Lead acetate, white crys., bbl., lb	.12½ – .13
Arsenate, powd. bags., lb	.11½ – .12
Lithopone, bags, lb	.04½ – .04½
Magnesium carb., tech., bags, lb	.07½ – .08
Methanol, 95%, tanks, gal	.60 –
Synthetic, tanks, gal	.24 –
Phosphorus, yellow, cases, lb	.23 – .25
Potassium bichromate, casks, lb	.10½ – .10½
Chlorate, pwd., lb	.09½ – .12
Hydroxide (cstic potash) dr., lb	.07 – .07½
Muriate, 60%, bags, unit	.53½ –
Nitrate, ref., bbl., lb	.08 – .09
Permangsnate, drums, lb	.19½ – .20
Prussiate, yellow, casks, lb	.16 – .17
Sal ammoniac, white, casks, lb	.0515– .06
Salsoda, bbl., 100 lb	1.00 – 1.05
Salt cake, bulk, ton	15.00 –
Soda ash, light, 58%, bags, contract, 100 lb	1.05 –
Dense, bags, 100 lb	1.15 –
Soda, caustic, 76% solid, drums, 100 lb	2.30 – 3.00
Acetate, del., bbl., lb	.05½ – .06
Bicarbonate, bbl., 100 lb	1.70 – 2.00
Bichromate, bags, lb	.07½ – .08
Bisulphate, bulk, ton	16.00 – 17.00
Bisulphite, bbl., lb	.03 – .04

CHEM. & MET.

Weighted Index of Prices for

OILS & FATS

Base = 100 for 1937

This month	153.39
Last month	145.80
July, 1945	145.85
July, 1944	145.55

Chlorate, kegs, lb	$0.06½ –	$0.06½
Cyanide, cases, dom., lb	14½ –	.15
Fluoride, bbl., lb	.07 –	.08
Hyposulphite, bags, 100 lb	2.25 –	2.50
Metasilicate, bbl., 100 lb	2.50 –	2.65
Nitrate, bulk, ton	27.00 –	
Nitrite, casks, lb	.06½ –	.07
Phosphate, tribasic, bags, 100 lb	2.70 –	
Prussiate, yel., bags, lb	.10½ –	.11
Silicate, 40°, dr., wks., 100 lb	.80 –	.85
Sulphite, crys., bbl., lb	.02¼ –	.02½
Sulphur, crude at mine, long ton	16.00 –	
Dioxide, cyl., lb	.07 –	.08
Dioxide, tanks, lb	.04 –	
Tin crystals, bbl., lb	.39½ –	
Zinc chloride, grain, bbl., lb	.05½ –	.06
Oxide, lead free, bags, lb	.07½ –	
Oxide, 5% leaded, bags, lb	.07½ –	
Sulphate, bbl., cwt	3.85 –	4.00
OILS AND FATS		
Castor oil, No. 3 bbl., lb	$0.14½ –	$0.15½
Chinawood oil, tanks, lb	.39 –	
Coconut oil, Ceylon, N. Y., lb	.0885 –	
Corn oil crude, tanks (f.o.b. mill), lb	12¼ –	
Cottonseed oil crude (f.o.b. mill), tanks, lb	12¼ –	12¾
Linseed oil raw, car lots, dr., lb	.177 –	
Palm, casks, lb	.0865 –	
Peanut oil, crude, tanks (mill), lb	12½ –	
Rapeseed oil, refined, bbl., lb	nom.	
Soybean, tanks, lb	11½ –	
Menhaden, light, pressed, dr., lb	16 –	
Crude, tanks (f.o.b. factory) lb	13 –	
Grease, yellow, loose, lb	11½ –	
Oleo stearine, lb	.09½ –	
Oleo oil, No. 1, lb	.13 –	
Red oil, distilled, bbl., lb	15½ –	
Tallow extra, loose, lb	11½ –	
COAL-TAR PRODUCTS		
Alpha-naphthol, crude, bbl., lb	$0.52 –	$0.55
Alpha-naphthylamine, bbl., lb	.32 –	.34
Aniline oil, drums, extra, lb	11½ –	.12¼
Aniline salts, bbl., lb	.22 –	.24
Benzaldehyde, tech., dr., lb	.45 –	.50
Benzidine base, bbl., lb	.70 –	.75
Benzoic acid, USP, kegs, lb	.54 –	.56
Benzol, 90°, tanks, works, gal	.15 –	
Benzyl chloride, tech., dr., lb	.22 –	.24
Beta-naphthol, tech., drums, lb	.21 –	.22
Cresol, USP, dr., lb	.10½ –	
Cresylic acid, dr., wks., gal	.81 –	.83
Diphenyl, bbl., lb	.15 –	
Diethylaniline, dr., lb	.40 –	.45
Dinitrotoluol, bbl., lb	.18 –	.19
Dinitrophenyl, bbl., lb	.22 –	.23
Dip oil, 15°, dr., gal	.23 –	.25
Diphenylamine, dr., f.o.b. wks., lb	.25 –	
H acid, bbl., lb	.45 –	.50
Hydroquinone, bbl., lb	.90 –	
Naphthalene, flake, bbl., lb	.09½ –	.10
Nitrobenzene, dr., lb	.08 –	.09
Para-cresol, bbl., lb	.41 –	
Para-nitroaniline, bbl., lb	.42 –	.43
Phenol, USP, drums, lb	.10	.11
Picric acid, bbl., lb	.35	.40
Pyridine, dr., gal	1.55 –	1.60
Resorcinol, tech., kegs, lb	.65 –	.70
Salicylic acid, tech., bbl., lb	.26 –	.33
Solvent naphtha, w.w., tanks, gal	.26 –	
Toluidin, bbl., lb	.96 –	
Toluol, drums, works, gal	.32 –	
Xylol, com., tanks, gal	.25 –	
MISCELLANEOUS		
Casein, tech., bbl., lb	$0.33 –	$0.35
Dry colors:		
Carbon gas, black (wks.), lb	.0365 –	.097
Prussian blue, bbl., lb	.36 –	.37
Ultramarine blue, bbl., lb	.11 –	.26
Chrome, green, bbl., lb	.24 –	.33
Carmine, red, tins, lb	4.60 –	4.75
Para toner, lb	.75 –	.80
Vermilion, English, bbl., lb	2.50 –	2.60
Chrome yellow, C.P., bbl., lb	.17 –	.18
Gum copal, Congo, bags, lb	.09 –	.55
Manila, bags, lb	.09 –	.15
Damar, Batavia, cases, lb	.10 –	.22
Kauri, cases, lb	.18 –	.60
Magnesite, calc., ton	64.00 –	
Pumice stone, lump, bbl., lb	.05 –	.07
Rosin, H., 100 lb	7.85 –	
Shellac, orange, fine, bags, lb	.75 –	
Bleached, bonedry, bags, lb	.70 –	
T. N., bags, lb	.72 –	
Turpentine, gal	1.10 –	1.12

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PACKING DISTRIBUTOR

NEW CONSTRUCTION

	Current Projects		Cumulative 1946	
	Proposed Work	Contracts	Proposed Work	Contracts
New England	.....	.....	$715,000	$5,319,000
Middle Atlantic	$5,985,000	$4,820,000	9,096,000	27,918,000
South	4,707,000	6,873,000	55,267,000	33,875,000
Middle West	.....	221,000	11,368,000	38,290,000
West of Mississippi	6,561,000	991,000	84,741,000	69,723,000
Far West	3,500,000	210,000	5,855,000	11,382,000
Canada	.....	.....	405,000	14,863,000
Total	$20,753,000	$13,115,000	$167,447,000	$201,370,000

PROPOSED WORK

Calif., Plaster City—U. S. Gypsum Co., 816 West 5th St., Los Angeles, plans to construct a group of five small and one large factory buildings here. Estimated cost $2,500,000.

Fla., Bartow—International Minerals & Chemicals Corp., 20 North Wacker Dr., Chicago, Ill., plans to construct a phosphate processing plant, mining and other facilities here. Estimated cost $2,680,000.

Fla., Cantonement—Florida Pulp & Paper Co., Cantonement, plans to improve and enlarge its production facilities. Estimated cost $627,200.

Ore., Portland—Flintkote Co., 907 N. W. Irving St., plans to construct a roofing factory. Estimated cost $500,000.

Pa., Philadelphia—Dilt & Collins, Div. of Mead Corp., paper manufacturers, Richmond and Tioga Sts., plan to construct a paper manufacturing plant. George F. Hardy, 441 Lexington Ave., New York, N. Y., Cons. Engr. Estimated cost $5,000,000.

Pa., Philadelphia—McNeil Laboratory, Inc., 2900 North 7th St., plans to construct an addition to its laboratory. Day & Zimmerman, Packard Bldg., Engrs. Estimated cost $385,000.

Pa., Whitehall—Asbestos Cement, Inc., Morecraft Bldg., Bound Brook, N. J., plans to construct additions to its plant here near Allentown. Estimated cost $600,000.

Tenn., Bristol—Knoxville Fertilizer Co., Maryville Pike, Knoxville, Tenn., plans to construct a plant here. Estimated cost $400,000.

Tex., Houston—Shell Oil Co., Inc., Shell Bldg., plans to construct a power and boiler plant in the Deere Park refinery area. Estimated cost $2,600,000.

Tex., Texas City—Carbide & Carbon Chemical Corp., Texas City, plans to construct a plant for the manufacture of "Ethyleneamines," a group of compounds which make alkaline solutions in water. Estimated cost $961,000.

Va., Covington—West Virginia Pulp & Paper Co., Covington, plans to construct a manufacturing plant. Estimated cost $1,000,000.

Wash., Bellingham—Puget Sound Pulp & Timber Co., Bellingham, plans to construct a 120x500 ft. pulp mill. Estimated cost $500,000.

Wyo., Casper—Texas Co., Casper, plans improvements at its refinery to include new crude still unit and unit for manufacturing road oils and asphalt products. Estimated cost $3,000,000. Also refinery plant improvements including fluid catalytic cracking and gas recovery unit. Estimated cost $3,000,000.

CONTRACTS AWARDED

Ark., Helena—Helena Cotton Oil Co., Helena, has awarded the contract for a cotton seed processing plant to Muskogee Iron Works, Muskogee, Okla. Estimated cost including equipment $225,000.

Calif., Lincoln—Gladding, McBean & Co., 1275 Harrison St., San Francisco, has awarded the contract for a clay products manufacturing plant to Markwart Co., Box 2071, Sacramento. Estimated cost $55,433.

Calif., Oakland—Par Soap Co., 1100 78th Ave., has awarded the contract for a 4 story factory to Stolte, Inc., 8451 San Leandro St. Estimated cost $100,000.

Calif., Trona—American Potash & Chemical Corp., Trona, has awarded the contract for an addition to its administration building, including experimental laboratory, to A. Farnell Blair, 7052 Santa Monica Blvd., Hollywood.

Fla., Jacksonville—Niagara Sprayer & Chemical Div. of Food Machinery Corp., Jacksonville, has awarded the contract for a manufacturing plant to E. C. Kenyon, Jacksonville. Estimated cost $135,000.

Fla., Sarasota—Southern Gas & Electric Corp., c/o A. J. Lawlor, Bradentown, has awarded the contract for a gas manufacturing plant to Stacy Dresser Engineering of Cleveland, Ohio Div. of Stacy Bros. Gas Construction Co., 5535 Vine St., Cincinnati, O.

Ga., Moultrie—C. O. Smith, Moultrie, will construct an addition to its fertilizer manufacturing plant. Work will be done by day labor. Estimated cost $250,000.

Ga., Savannah—General Chemical Co., Savannah, has awarded the contract for a chemical plant to San-Worrell Construction Co., Savannah. Estimated cost $55,000.

La., Lake Charles—Southern Alkali Corp., Corpus Christi, Tex., has awarded the contract for a chlorine plant here to H. K. Ferguson Co., M & M Bldg., Houston, Tex. Estimated cost $6,000,000.

Md., Baltimore—National Gypsum Co., 325 Delaware Ave., Buffalo, N. Y., has awarded the contract for a gypsum manufacturing plant here to Baltimore Contractors, 711 South Central Ave., Baltimore. Estimated cost $2,000,000.

Miss., Jackson—Armstrong Cork Co., Jackson, has awarded the contract for a plant to Capitol Building Co., Jackson. Estimated cost $355,000.

Mont., Cut Bank—Union Oil Co. of California, Cut Bank, has awarded the contract for an addition to its absorption plant to Bechtel-McCone Corp., 601 West 5th St., Los Angeles, Calif. Estimated cost $200,000.

N. J., Burlington—Hercules Powder Co., 900 Market St., Wilmington, Del., has awarded the contract for a chemical plant here to Buck & Donohue, 790 Broad St., Newark. Estimated cost $1,500,000.

O., Cleveland—Ferro Enamel Co., 4150 East 56th St., will construct extensive alterations and additions to its plant. Work will be done by separate contracts. Estimated cost $86,000.

O., Cleveland—Sherwin-Williams Co., West 4th and Mahoning Sts., has awarded the contract for a laboratory addition to H. K. Ferguson Co., Hanna Bldg., at $75,000.

Pa., Dallas—Natona Co., Dallas, has awarded the contract for the construction of a dye plant and manufacturing building to Sordoni Construction Co., 45 Owen St., Forty Fort, Pa. Estimated cost will exceed $55,000.

Pa., Johnsonburg—General Chemical Co., 40 Rector St., New York, N. Y., will construct a 1 story factory building. Work will be done by separate contracts. Estimated cost $55,000.

Pa., Linfield—Publicker Industrial Alcohol Co., 1429 Walnut St., has awarded the contract for four warehouses to McCloskey & Co., 1620 West Thompson St. Estimated cost will exceed $200,000.

Pa., Marcus Hook—Sinclair Refining Co. has awarded the contract for a refinery to C. F. Brown, Alhambra, Calif. Estimated cost $250,000.

Pa., Philadelphia—Atlantic Refining Co., 260 Broad St., has awarded the contract for a refinery addition to M. W. Kellogg Co., 225 Broadway, New York, N. Y. Estimated cost will exceed $250,000.

Pa., Philadelphia—Philadelphia Gas Works Co., 1401 Arch St., will construct additions to its gas works. Work will be done by separate contracts. Estimated cost will exceed $250,000.

Pa., Royersford—Diamond Glass Co., Royersford, has awarded the contract for enlarging its plant to W. W. Lindsay, 4 South 15th St., Philadelphia. Estimated cost $260,000.

Tex., Dallas—Atlantic Refining Co., 260 South Broad St., Philadelphia, Pa., has awarded the contract for a laboratory and garage here to Nathan Wohlfeldt, 5027 Willis St., Dallas. Estimated cost $450,000.

Tex., Freeport—Dow Chemical Co., Freeport, has awarded the contract for the construction of a pumping plant on the Brazos River to R. P. Fransworth & Co., Inc., P. O. Box 74, Houston. Estimated cost $116,000.

Wis., Milwaukee—Harrison Oil Co., 5110 West 35th St., has awarded the contract for an oil blending plant to Dahlman Construction Co., 4200 North Palmer St. Estimated cost $60,000.